Al.1.478

1 [Alta]

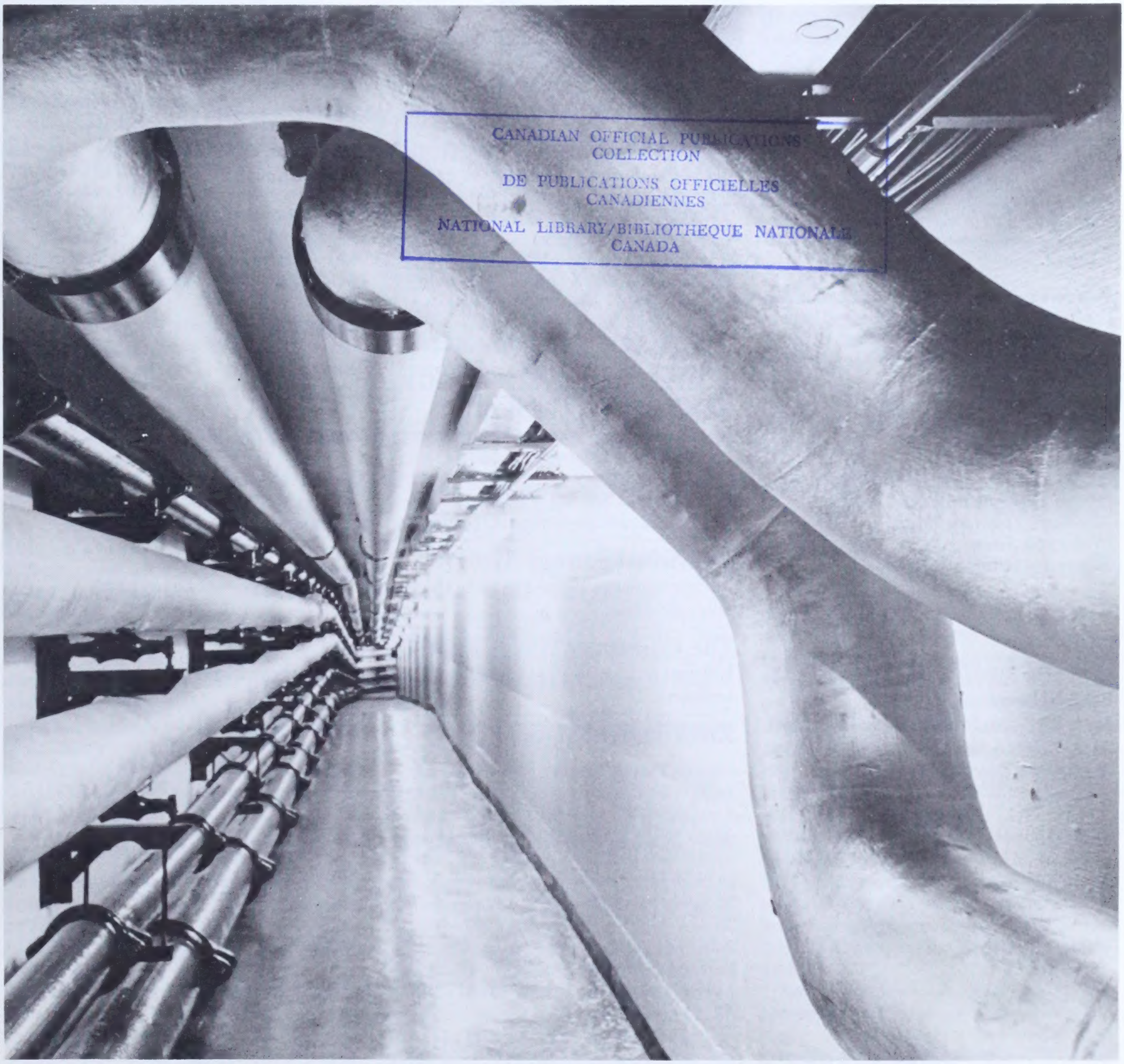
ENVIRONMENT VIEWS

VOLUME THREE
NUMBER ONE
APRIL MAY 1980

SECOND CLASS MAIL REGISTRATION NUMBER 4405

CANADA
JUN 16 1980

CANADIAN OFFICIAL PUBLICATIONS COLLECTION
DE PUBLICATIONS OFFICIELLES CANADIENNES
NATIONAL LIBRARY/BIBLIOTHEQUE NATIONALE CANADA



Lauren Dale

Sewage Disposal

ISSN 0701-9637

ENVIRONMENT VIEWS

Contents

Environment Views is published bi-monthly by Alberta Environment. Each issue deals with a specific topic from various viewpoints with the aim of increasing awareness of environmental issues among Albertans. The views expressed by the publication are not necessarily those of Alberta Environment.

Subscriptions are free and can be obtained by mailing the enclosed card. When notifying *Environment Views* of a change of address, please quote the subscription number on your mailing label.

Permission to reproduce any part of this publication for commercial purposes should be obtained by writing the address below. Reproduction for other purposes should credit this publication.

Letters to the editor are welcomed, and should be sent to The Editor,
Environment Views,
Alberta Environment,
Communications Branch,
12thFloor, Oxbridge Place,
9820 - 106 Street,
Edmonton, Alberta T5K 2J6

Editor:
Gillian Sniatynski

Editorial Board:
Joe Will, Susan Bramm, Dave Graveland, Carey Johannesson, John Russell, Susan Washington, Ron Woznow.

Sewage Disposal 3
Our attitudes may greatly complicate the issue.

Getting The Treatment 7
A guide to sewage treatment methods in Alberta communities.

Economy, Efficiency — And *Sometimes* A Smell! 11
Sewage lagoons are a much-used means of sewage treatment.

Taking The 'Waste' Out Of Wastewater 13
Irrigation is one way to make use of it.

Sludge Comes Out Of Storage 15
It's finding a new role as a soil-enricher.

A Scramble To Keep Ahead 18
That sums up Edmonton's sewage treatment history.

The Battle Of The Bow 21
Nutrients mainly from discharged sewage effluent have stimulated unwelcome weed growth in the river.

Planning For Growth 24
Inadequate sewage treatment facilities can paralyze community expansion.

Individual Sewage Systems 27
There are alternatives available to those who can't, or won't, use conventional sewer systems.

The Consumer Has A Role To Play 30
Efficient sewage disposal isn't only the responsibility of the sanitation engineers.

Environment Update 32

Cover photo: Pipeline network at Edmonton's Gold Bar wastewater treatment plant.

Alberta
ENVIRONMENT

Introduction Gillian Sniatynski

Sewage Disposal

Is it cleaning up a nuisance, or harnessing a resource?

Lovely juicy tomatoes this year. Care for a bite?

There's an old man on the Wuxing commune in northern China whose job it is, morning and afternoon, to collect the manure left on the roadways by the commune's work horses.

He scoops it up carefully, deposits it in the straw baskets hanging from his bicycle, and takes it home. There, mixed in a compost pit with the other human wastes from his household, he makes methane gas with it for heating and cooking. Then he delivers all the compost to agricultural workers who will use it as fertilizer on the commune's grain fields.

The old man told the crew shooting the fascinating National Film Board film "North China Commune" that picking up the manure was his contribution to running the country well. He, like all other members of the commune, regards human and animal wastes as a precious resource.

Human toilets are located next to the pig pen in the courtyard of most Wuxing homes, so all wastes are kept together and collected. They add up to 100,000 metric tons of organic compost a year — plus "work points" (the commune's pay scale) for those who supply it.

And excellent use is made of it. The compost is the only fertilizer used on the commune's 1,200 hectares of land, yet that land produces two crops a year, with wheat yields better than those achieved in Canada. Soil fertility is improving all the time. The land feeds 14,500 people, and their animals, and there's a grain surplus for sale to other areas of the country.

What a contrast in attitude to modern Western society. Instead of regarding our wastes as a resource, we actually *pay* to have them flushed as far out of sight and mind as possible.

There are no sewage disposal problems on the Wuxing commune. But we persist in regarding our wastes as an unpleasant nuisance, and ask our municipal engineers to do something about it.

Historically, those engineers seem to have been fairly innovative. According to F.L. Small's history of urban water supply and sanitation, called "The Influent and the Effluent," archeologists have found masonry sewers dating back before 3750 BC. There were even water-flushed latrines in the Minoan civilization on Crete from 2500 to 1400 BC.

Today, sewage disposal problems relate mainly to sheer volume.

The water-based system common to most Canadian communities makes a very dilute sewage, and, at 24 litres or five gallons a flush, greatly increases the volume to be treated. For instance the Gold Bar wastewater treatment plant which handles most of Edmonton's sewage treats an average 55 million gallons a day.

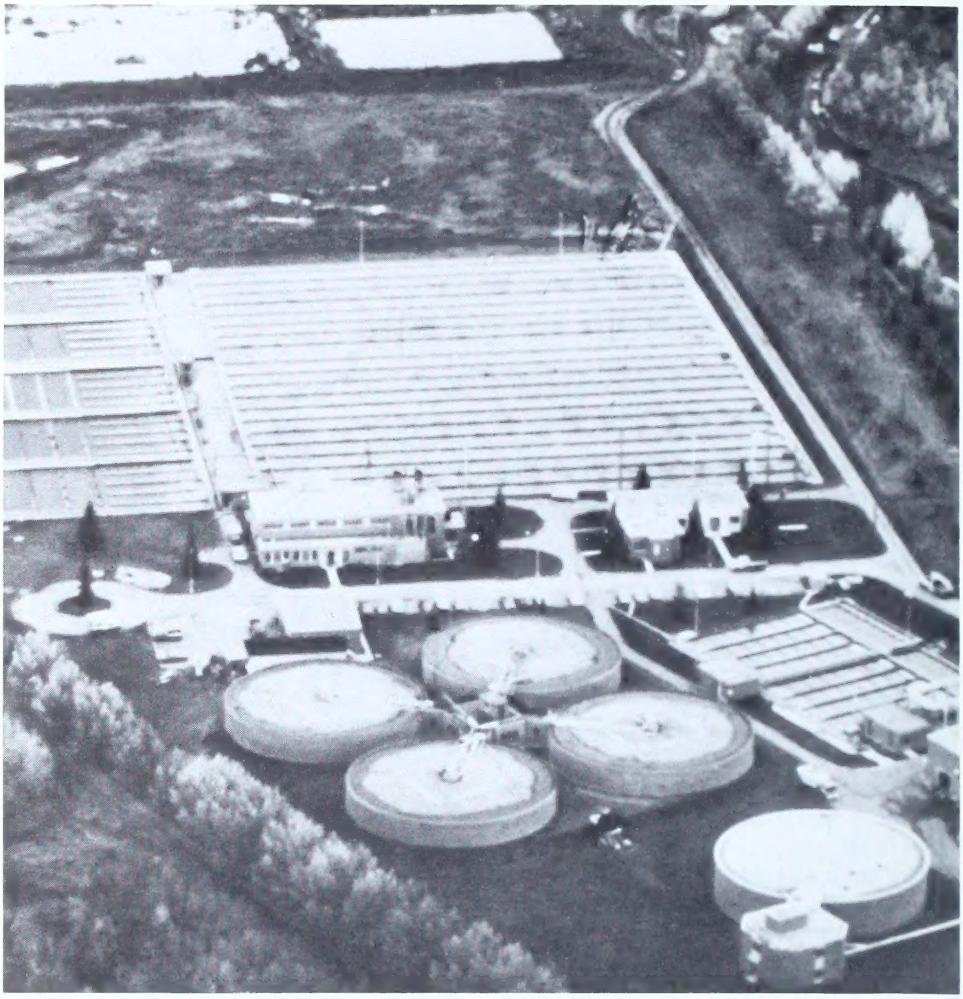
Our sewage is 99 per cent water. Treatment involves removing the small proportion of solids in the water and making it clean enough to return to the environment. So there are basically two products to be disposed of — the liquid effluent, and the mixture of solids which form a runny, muddy sludge.

There are several ways in which this treatment happens, as the story on Page 7 shows. Most of the 300 or so Alberta municipalities with sewage treatment facilities use sewage lagoons like those described on Page 11. But the greatest *volumes* of sewage are handled at mechanical treatment plants like Gold Bar, where, as the story on page 18 notes, about 90 per cent of solids are removed from the plant's effluent discharged to the North Saskatchewan River.

Discharge to rivers is a common effluent disposal technique. And if, like the North Saskatchewan, the river is large, with a high capacity to break down any remaining solids without causing undue harm to its life forms, then environmentally it's an acceptable option.

But river discharge is a clearly unacceptable option for some other communities.

This is because sewage effluent, however well treated, invariably contains some solids whose breakdown requires oxygen — and



Aerial view of Gold Bar plant (right); Gold Bar primary settling tanks (below, far right).

this "biological oxygen demand" can overtax the oxygen resources of some small rivers, especially during the winter, when ice cover prevents aeration from the surrounding air.

The effluent also contains some nutrients, which may stimulate unwelcome plant growth — like that fouling reaches of the Bow River near Calgary, as the story on Page 21 indicates.

The other side of sewage disposal concerns the sludge. Edmonton, for example, currently produces about 350,000 gallons a day — and nothing at all is done with much of it. It's pumped to sludge storage lagoons at Clover Bar, and there it sits. When lagoon cells are filled, new ones are added. Already some 64 hectares of Edmonton real estate have been given over to sludge storage. And the storage approach is common to most Alberta sewage treatment facilities.

But chances are we'll have to change our thinking in the future, both on effluent and sludge disposal.

For one thing, large urban areas may simply run out of land for lagoons.

Dr. Steve Hrudey, associate professor of civil engineering at the University of Alberta, also sees a future concern about effluent disposal in the growth forecast for the province.

"Population centres where the growth is going to be expanded are not necessarily located on huge assimilative capacity rivers," he says.

"It's not too difficult to see that if you increase the population to several millions even rivers like the (North) Saskatchewan could have problems."

The solution to our effluent disposal problems could lie in either of two directions: we could summon up the technology to improve effluent treatment to the point where even greatly increased volumes wouldn't hurt the rivers; or we could look for alternatives to river discharge.

The story on Page 13 describes some of the alternatives — like land application for irrigation — now being used in Alberta to dispose of effluent. There are still other options.

Hrudey notes that in parts of the southern United States work is being done on groundwater recharge; the effluent is added to the groundwater with the assumption that by the time it reached a source of drinking water its passage through the soil would have completed the purification process.

In dry climates, total recycling of the effluent is an attractive idea. The Upper Occoquan Sewage Authority near Washington, D.C., treats its wastewater to such a degree that it can be discharged directly into a water supply reservoir and used for drinking water. (In that system, too, ammonia is recovered for use as a fertilizer, the organic sludge is composted for use as a soil enricher, and the methane gas from this process used as a heating fuel.)

Northglenn is a small community in the suburbs of Denver. It borrows water from the local Farmers' Reservoir and Irrigation Company, uses the water, collects the sewage effluent, treats it and then returns it to the farmers during the irrigation season.

Other systems make use of aquaculture, in which plants such as water hyacinths or bulrushes are grown on the effluent and absorb a large proportion of the solids suspended in it.

Closer to home, the Canadian Mortgage and Housing Corporation, through the Ontario Research Council, is supporting the Canwel (Canadian water energy loop) system of waste management. Canwel technology has produced effluent of sufficiently pure quality that it doesn't need dilution in a large water body to complete the breakdown process. A possible offshoot of the Canwel research might be the use of such highly treated effluent for utility purposes like street cleaning, which would save on valuable drinking water.

There still remains the problem of sludge disposal; and the more highly treated the effluent, the more sludge is left. At a 1977 seminar in Calgary on sludge handling and disposal, P.D. Lawson of the engineering consulting firm Reid Crowther and Partners Limited, said it this way: "Essentially in sewage treatment we are trying to remove from the originally unpolluted water all the substances we have put into it during its use. The purpose of all sewage treatment processes is therefore to produce sludge, the more sludge produced the better the sewage treatment process."

The story on Page 15 discusses sludge disposal options like its application as a soil amendment or enricher to farmland. Sludge so applied isn't an unmixed blessing; it may contain heavy metals and other contaminants which in large enough quantities could get into the food chain through plant growth. It has to be spread fairly thinly, and that calls for a lot of land.

On the other hand, as Alberta Environment agrologist David McCoy told the Calgary seminar already mentioned, "because sludge contains most, if not all, of the elements physiologically essential to plants, it has been regarded as a valuable soil additive or amendment." (And that would not be news to the Wuxing commune.)

Sludge has been used effectively to reclaim strip mines. Why not use some of ours to reclaim the tar sands, asks Dr. Dixon Thompson, program director of environmental science at the University of Calgary's faculty of environmental design. Why go so far afield, asks John Ward, chief of wastewater treatment for the City of Edmonton. He says there are numerous locations nearer the city — like gravel pits, or other sites of large-scale excavation.

We may hear much more about sludge. The September-October, 1979, edition of the journal Compost Science/Land Utilization quotes John M. Walker, of the U.S. Environmental Protection Agency's office of waste program operations:

"Years of actual operations, demonstration projects and research have shown that many sludges can be used beneficially in agriculture, for revegetation of disturbed lands, in forests, on parklands and elsewhere. The use of these organic sludges improves soil by adding essential nutrients as well as by causing a more favorable physical environment for plant growth, i.e. improving the ability of sandy soil to hold moisture and the porosity of a clay soil for air and root penetration. This results in increased yields of grain, forages and other crops grown on sludge-amended soils, often in excess of that which can be obtained from the use of synthetic fertilizers alone."

Walker attaches some dollar values too. He estimates that in U.S. sludge in 1978, there were some $93 million worth of nitrogen, phosphorus and potassium.

Composting of sludge, or its mechanical digestion in a treatment plant, also yield methane gas. (At Gold Bar the methane is used to heat the plant.) And the compost can be sold and used. For example, sludge from Los Angeles county is used by retail nurseries, wholesale nursery growers, landscape contractors, golf courses, cemeteries, schools, parks and other recreational areas such as football and baseball stadiums.

Some of the technologically sophisticated options for effluent and sludge disposal may not come cheap. It seems likely that some economies of scale can be achieved when small communities or regions work together on sewage disposal, or link up with already existing large urban systems. Regional systems are now being proposed in some areas of Alberta.

One of the largest regional systems in existence is the Metropolitan Sewage District of Greater Chicago. Ed Podivinsky, chief sanitation engineer for the City of Edmonton, has toured the district's facilities, which he says serve some some six million people. There are three treatment plants, the biggest of which handles 1.3 billion gallons a day. Sludge is disposed of in several ways: the greatest bulk is partly dewatered, then pumped on to barges which tow it to a former strip mine some 240 kilometres way; other methods include composting, land application, heat drying and pulverizing to convert sludge to a form useable as fertilizer.

Lauren Dale

Podivinsky says he is in general agreement with provincial inclinations towards regional systems here, too, as being best suited for the region. And "I think by having one . . . facility you can afford to have better personnel, better equipment, and probably better control over what is going on."

Not everyone agrees.

"My concern is that usually what happens when somebody is analyzing the possibility of using regional systems is that they do it on the basis of short-term economics only," says Dr. Bill Oldham, head of the environmental engineering section of civil engineering at the University of British Columbia.

Short-term economics usually favor the regional option as being cheaper than several smaller facilities, but, says Oldham, what really needs to be considered is how this choice affects future choices. Committing all the effluent and all the sludge to one system increases the volumes that eventually have to be disposed of from that single location; options like land application would be impractical because too much land would be needed.

Sewage system choices aren't always easily made, as the story on Page 24 shows. Many Alberta communities are grappling with the issues now as they seek to take advantage of two government grant programs.

The provincial government's municipal water supply and sewage treatment grant program, run by Alberta Environment, contributes generously to the cost of adding to, or building new, facilities. Municipalities pay $200 per capita, and grant money provides 90 per cent of the remaining costs, up to $2,000 per capita. From November, when the program got under way, to the end of January, $12.9 million had been paid out or approved for payment.

The federal community services program which Alberta Environment administers, provided $6.65 million in 1979 towards sewage and water treatment projects. This year's grant allocation will be $12.7 million. The grants are intended to cover one-sixth of individual project costs; usually they are used to supplement the provincial grants on projects whose costs greatly exceed provincial funding limits.

These programs represent millons of dollars going into conventional sewage systems. And while these are the systems most of us know best, there's a feeling among many environmentally concerned individuals and groups that such systems may not always *be* the best.

The Toronto-based environmental group Pollution Probe is currently fitting up an old three-storey building as an "ecology house." One of its features will be a waste management system independent of Toronto sewers. A composting toilet will be included; human wastes (plus organic kitchen scraps) will be collected in its large collection chamber and converted over time, by bacterial action, to compost. Other household water will also be treated on site.

Pollution Probe researcher Moni Campbell says the idea of the waste management system is to show people that modern technology can offer alternatives to sewage systems which use vast quantities of water and considerable energy for collection and treatment.

Some people, of course, live in areas which aren't sewered anyway. They have to use the sorts of individual systems described in the story on Page 27.

By far the most common individual systems are the septic tanks with leaching fields. But, as California architect and consultant Sim Van der Ryn discovered several years ago, the land which is best for septic tank leaching fields is also usually the best agricultural land. And he was concerned about excessive water use for such systems in areas where water shortages were a potential problem. He began to investigate the waterless, composting toilet option, and wrote a book about it called "The Toilet Papers."

Van der Ryn was also manager of a California project to examine on-site toilet systems and disposal of greywater (waste water from kitchen, bathroom and laundry) in rural areas.

The report on the project, as quoted in the May-June, 1979, issue of Compost Science/Land Utilization, notes that:

- an on-site system can be much cheaper than a central system;
- water is typically returned to the *local* water table in small doses — there's no final effluent disposal problem as with a big plant;
- dry toilets mean a water saving of 45 per cent;
- dry toilets mean that land unsuitable for leaching fields, or where water is in short supply, can still be used for housing.

The Journal's March-April, 1979, issue gives details of a thesis on composting toilets by a graduate student at the University of British Columbia's school of community and regional planning. The conclusion is that the composting system is suitable for disposing of body wastes, and if supplemented by a filtration system for cleaning greywater, could be used in place of conventional centralized collection and treatment facilities in most areas except high-density urban communities. Van der Ryn claims it's perfectly appropriate in cities too.

In Alberta, at least, such systems have few advocates. W.A. Milligan, chief plumbing inspector for Alberta Labor, says that of the 4,000 or so individual systems approved in the province, only a tiny proportion have been waterless. And he estimates that in the past seven or eight years, about 80 per cent of that proportion have been torn out because of odor.

In California, Sim Van der Ryn describes progress towards waterless systems as "discouragingly slow." He says there's no question that composting toilets require more maintenance. But they *can* work effectively and unobtrusively; it's all a question of attitude change.

If composting toilets haven't caught on in rural areas where they might be considered especially appropriate, perhaps it's not surprising that city dwellers aren't too interested either. And after all, most cities have sewage systems already established. They've costs million of dollars, and, says Pollution Probe's Campbell, we can't just ignore them. What perhaps we *can* do is give some thought to sewerless systems, or low-flush toilets, in new sub-divisions.

Meanwhile the great majority of us, whose homes are plugged into those conventional systems, continue to make extravagant use of our water resources and add to the large-scale disposal burden.

Can we do anything about it? As the story on Page 30 points out, being careful about the quantity of water we use, and watching what we flush away, are certainly starting places.

Akio Masuda, head of Alberta's Environment's water quality control branch, says that sewage effluent is having little detrimental effect on Alberta rivers and streams. If it were, he says, the technology exists simply to improve the quality of the effluent and overcome the problem.

And our cities and smaller communities are not *yet* stuck for ways of dealing with sewage sludge.

But by continuing to build conventional, water-based sewer systems we are committing ourselves to reactive measures at the end of the process, rather than doing some preventive planning earlier on.

We do still have time to plan, says the U of A's Hrudey.

"But it's something that needs to be planned for very shortly."

Gillian Sniatynski is the freelance editor of this magazine.

Getting The Treatment

David Spink

An inventory of sewage treatment methods in Alberta.

Oxidation ditch, Coleman.

Water is one of Canada's most valuable natural resources. The use of this resource for domestic purposes, and the treatment and disposal of wastewater from this use, are important considerations in water management and planning.

In Alberta approximately 160 million gallons (768 million litres) of water per day are used for domestic purposes. Most of the domestic uses of this water i.e. bathing, dishwashing, toilet flushing, etc. produce a wastewater commonly referred to as sewage. The substances and organisms in sewage may include: (a) infectious worm, protozoan, bacteria and virus organisms; (b) oxygen-demanding wastes such as carbohydrates, fats and proteins; (c) plant nutrients such as ammonia and phosphates; (d) organic chemicals such as pesticides; (e) inorganic chemicals such as heavy metals; and (f) sediment such as silt and sand. The removal of these substances from sewage can be an integral part of the overall protection of water resources against pollution.

To achieve a desired level of sewage treatment, a number of different processes are involved. The basic sewage treatment processes, in the sequence they would normally be found in a sewage treatment plant, are:

1. screening: screening removes large material such as rags, sticks, rocks etc. from entering the plant and clogging or damaging piping and pumps.

2. grit removal: grit refers to sand, silt and other inorganic material in sewage. This material is removed by passing sewage through a tank, commonly referred to as a grit chamber. In this chamber the sewage is aerated and mixed for about five minutes. Sufficient mixing is provided to keep the organic solids in the sewage in suspension; the heavier inorganic solids settle to the bottom of the chamber. These solids are removed on a regular basis and normally disposed of in a sanitary landfill.

3. comminution: comminution involves grinding the solids in sewage to a size that will not damage pumping equipment. In general comminutors reduce solid sizes to less than one centimetre.

4. primary settling: primary settling is generally the first major treatment process employed at sewage treatment plants. In this process, sewage enters large settling tanks or clarifiers where under quiescent (motionless) conditions some of the solids are separated from the sewage. The solids are collected for further treatment and/or disposal and the clarified sewage may be discharged as effluent or further treated. Approximately 20 to 40 per cent of the organic materials and 30 to 50 per cent of the suspended solids in raw sewage are removed by primary settling. This process by itself or in combination with screening, grit removal and/or comminution is often referred to as primary treatment.

5. biological treatment: biological treatment involves putting living micro-organisms (biological solids) with sewage under aerobic conditions (i.e. in the presence of oxygen.) The micro-organisms utilize the organic material in the sewage for food; this results in an increase in the number of micro-organisms and a decrease in the organic content of the sewage. Wastewater from biological treatment consists of treated sewage and biological solids. The treated sewage is separated from the biological solids in settling tanks normally referred to as "secondary" or "final" clarifiers. The biological solids collected in the secondary clarification may either be treated as a waste sludge or recycled back to the biological treatment tanks. Biological treatment followed by clarification is referred to as "secondary" treatment and will remove 85 to 95 per cent of both the organic material and suspended solids in sewage.

The solids collected in the primary and secondary clarifiers are called sludge. This sludge is approximately 98 per cent water and requires further treatment prior to disposal. Treatment may consist of: thickening; biological treatment either aerobic or anaerobic; lagooning; dewatering; or a combination thereof. Disposal may be by incineration, landfilling, land application or permanent storage in sludge lagoons.

In Alberta, all municipalities are required to treat their sewage to the "secondary" treatment level. This level will result in the removal of 85 to 95 per cent of the oxygen-demanding waste material and 85 to 95 per cent of the suspended solids in the sewage. Where this level of treatment does not provide sufficient protection to the water environment additional treatment may be required. The disinfection of the Town of Devon's sewage treatment plant effluent to protect the City of Edmonton's water supply is an example of the need for additional treatment. The City of Calgary, in an effort to reduce algae and weed growth in the Bow River, plans to control the amount of phosphorus in its sewage discharges. This is another example of environmental need dictating the provision of sewage treatment beyond the secondary level. These situations, however, are the exception and in general the province's secondary treatment standard is sufficient to control pollution by sewage discharges.

Inventory of Sewage Treatment Systems in Alberta

A 1978 Alberta Environment wastewater facilities survey reported that 295 communities were served by some type of sewage treatment system, and another eight communities had facilities planned. The total population served by sewage treatment systems in 1978 was estimated at 1,537,918.

Many types of sewage treatment facilities meet a "secondary" treatment requirement.

Type of Sewage Treatment* In Use in Alberta in 1978	Number of Communities Using the Type of Treatment**
Lagoons	264
R.B.C. (Rotating Biological Contactor) Plants	5
Oxidation Ditches	5
Extended Aeration Plants	7
Activated Sludge Plants	4
Septic Tanks	3

* In some cases a sewage treatment system may be a combination of the systems listed i.e. an R.B.C. plant followed by lagoons.

** Some communities are connected to another community's system.

The types of sewage treatment systems used by communities in Alberta are typical of those used throughout Canada and the world.

Lagoons

Lagoons are commonly employed as secondary treatment systems in Alberta and throughout North America. Consisting of earthen basins open to the sun and air, lagoons depend on natural biological, chemical and physical processes to stabilize wastewater. These natural processes may be artificially modified to enhance treatment efficiencies e.g. air may be artifically added, in which case the treatment system is referred to as aerated lagoons.

The major advantages of lagoons are:

1) they are simple to operate;
2) they are less subject to process disruptions due to variations in hydraulic and/or organic loading (in other words, volumes and strengths of sewage) than mechanical wastewater treatment systems;
3) they cost less to operate and maintain than mechanical treatment systems;
4) in general, for smaller communities, they have a lower capital cost than mechanical treatment systems.

The major disadvantages of waste stabilization ponds are:

1) they require larger land areas than mechanical treatment systems;
2) they are subject to seasonal variations in performance which in turn necessitate storage and intermittent effluent discharges;
3) they may emit nuisance odors if not designed and operated properly.

When properly planned, designed and operated waste stabilization ponds can be a cost-effective method of wastewater treatment particularly for smaller communities.

Grande Prairie is the largest municipality in the province using a natural lagoon system. The Cities of St. Albert and Medicine Hat use aerated lagoons as do the Towns of Turner Valley and High River. Athabasca, Ponoka, Wainwright, Crossfield and Claresholm are some of the other communities in the province which use some type of lagoon system. *(For more information about lagoons, see the story on Page 11.)*

R.B.C. Plants

Research on Rotating Biological Contactors began in Europe in the 1930s, but commercial use of the process did not begin until 1959.

Rotating Biological Contactors consist of a series of closely spaced plastic discs anchored to a shaft which is supported just above the surface of the waste to be treated. The lower portion of each disc extends into the sewage while the upper portion of the disc rotates in the air. A biological growth or film attaches to the disc and this biological film is alternately submerged in the sewage to absorb organics and then raised out of the sewage to absorb oxygen. The disc rotates slowly, typically at one revolution per minute.

Sewage normally, though not always, undergoes some form of primary treatment prior to discharge to R.B.C. units. Effluent from the R.B.C. units goes to a secondary clarifier where biological solids are allowed to settle and clear liquid is decanted and discharged as treated sewage effluent.

The advantages of R.B.C. plants are that

R.B.C. building, Innisfail.

they are simple to operate and are less subject to upsets than activated sludge plants. Economics, however, appear to favor smaller R.B.C. plants rather than large-scale installations and in Alberta they are limited to communities with populations in the 3,000 to 10,000 range.

The Towns of Fort MacLeod, Canmore, Innisfail, Devon and Olds all have R.B.C. sewage treatment facilities. Innisfail and Olds store their R.B.C. plant effluent in large storage lagoons which are discharged twice a year. This is necessary because the drainage courses into which effluent is discharged cannot accommodate a continuous discharge i.e. they are dry drainage courses most of the year.

Activated Sludge Plants

The activated sludge process was developed in England in 1913. It involves mixing biological flocs (micro-organisms) under aerobic conditions with liquid wastes that have usually undergone primary clarification. This mixture of micro-organisms, organic matter and inorganic matter is mixed and aerated until the organisms have utilized most of the available organics. During this period there is an increase in the number of organisms and the amount of biological floc. After sufficient aeration and mixing (up to six hours) flow enters settling tanks. Effluent from the settling tanks is discharged as final effluent and the solids that settle are pumped back to the aeration basin and used as the biological floc. This recycle of solids is continuous. To compensate for the increase in solids that occurs due to microbial growth, a small portion of the sludge is wasted from the system continually.

For large-scale installations the activated sludge process is very efficient and is generally the most economical.

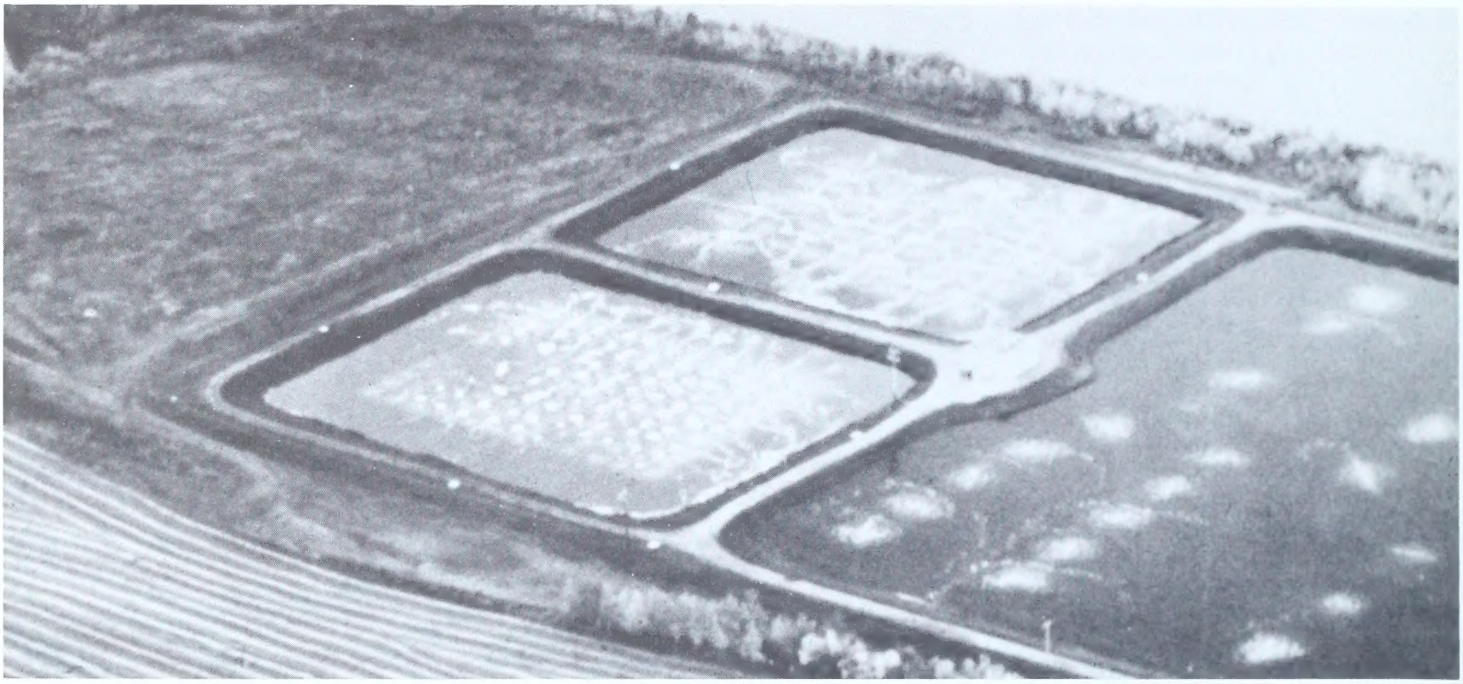
But it requires considerable operational control and is therefore suited to large communities that can afford full-time operating and maintenance staff.

The Cities of Edmonton, Calgary, Lethbridge and Red Deer have activated sludge sewage treatment facilities. The new City of Calgary Fish Creek sewage treatment plant uses an activated sludge process which is aerated with pure oxygen rather than air. By using pure oxygen a greater concentration of biological mass can be maintained in the aeration tanks and these tanks can be reduced in size, since less contact time between the micro-organisms and waste is required to stabilize the sewage.

Oxidation Ditches

The oxidation ditch sewage treatment process was developed in Holland in the early 1950s. The process is a modification of the activated sludge process, using a suspended biological floc to remove the organic material from sewage. Primary clarification is not required as part of oxidation ditch systems. Screened and/or comminuted sewage is added directly to the oxidation ditch, which is oval in shape and normally has a trapezoidal cross-section of shallow depth (hence the term "ditch"). One or more rotors are used both to entrain oxygen into the sewage biological floc mixture in the ditch and keep the contents of the ditch mixed and moving. A velocity of the liquid of about one foot per second is required to prevent solids from settling. The rotors are large circular rotating brushes which are partially submerged in the ditch. The sewage-biological floc mixture from the ditch, after about 18 to 30 hours of aeration, enters a clarifer where the solids settle and clarified liquid is discharged as final effluent. Most of the solids that settle in the clarifier are recycled backed to the ditch and the remainder of the solids are wasted i.e. go to the sludge treatment system. Oxidation ditch systems, because of the long aeration times required, are not economic for large-scale installations and are therefore used only by smaller communities. They are relatively easy to operate and are not as subject to upsets as activated sludge systems. The quantities of sludge produced by oxidation ditches are less than the sludge quantities produced by activated sludge systems or R.B.C. systems, so sludge treatment and disposal costs are less. The major disadvan-

Aerated lagoons, St. Albert.



tage of oxidation ditches is that they have a very high surface area to volume ratio which enhances heat loss. In colder climates, such as Alberta's, this high heat loss can result in rotor icing problems and decreased system efficiency.

Blairmore, Coleman, Okotoks, Nanton and Longview are the five communities in Alberta which treat their sewage with oxidation ditches.

Extended Aeration Plants

The extended aeration plant process is another modification of the activated sludge process and is very similar to the oxidation ditch process.

Primary treatment is not normally provided at extended aeration plants. Screened and/or comminuted sewage is normally mixed and aerated with a biological floc for 18 to 30 hours and then discharged to a final clarifier. The quiescent conditions in the clarifier allow the solids to settle and the clarified liquid is discharged as final effluent. As with the activated sludge and oxidation ditch processes the settled solids are recycled back to the aeration tank and excess solids are wasted.

The long aeration time required for the extended aeration process makes it an uneconomical method of sewage treatment for large communities. However, the process is relatively easy to operate and produces less sludge than the activated sludge process. It's therefore useful in small to medium-sized communities.

Drumheller, Leduc, St. Paul, Turner Valley, Whitecourt, Rosedale and Vermilion are communities in Alberta which have extended aeration sewage treatment systems.

Septic Tanks

Septic tanks are enclosed rectangular tanks consisting of one or two chambers, which are generally buried 30 to 60 centimetres below ground level. Solids settle in the tank and undergo anaerobic decomposition. The liquid portion of the sewage also undergoes anaerobic treatment in the septic tank. The sewage in a septic tank is discharged all at once whenever the tank is full (approximately once per day). The solids that collect in the septic tank have to be pumped out periodically (once or twice a year). In a two-chamber septic tank only the contents of the second chamber are discharged. Discharge from a septic tank should be to a cesspool or tile field and not directly to a watercourse since the effluent from a septic tank is still high in oxygen-demanding wastes.

Septic tanks in combination with tile fields or cesspools are commonly used to treat sewage from rural residences and cottages and are generally not economical or practical for use by even small communities unless each residence is served by its own system and this requires large lot sizes (1,800 square metres). However, in the past, some very small communities in Alberta used septic tanks alone to treat their sewage. These systems are gradually being phased out since they do not meet the province's secondary treatment standard. The communities which still use septic tanks are Big Valley, Derwent and Hays.

David Spink is an engineer in Alberta Environment's municipal engineering branch.

Jack Spearman

Economy, Efficiency — And *Sometimes* A Smell!

In general, sewage lagoons serve Alberta communities well.

There's no denying that on a hot summer's day in sunny Alberta, sewage lagoons sometimes smell. And they take up acres of land on the outskirts of just about every town and city in the province.

But despite these apparent drawbacks, the fact is that sewage lagoons are a relatively inexpensive and efficient method of breaking down wastes into a form that can be discharged into rivers and watercourses.

Sewage lagoons are the primary method of treatment in many municipalities, including such relatively large centres as Grande Prairie, population 22,000.

The lagoons are dug in a series and work on natural principles of bacterial decomposition. No chemicals need be added to speed up the process. And by varying the depth of the lagoons to suit different kinds of bacteria, the sewage that heads into the system will emerge about 90 per cent pure by the time it enters a holding pond at the end of the chain six weeks or so later.

The first step is the anaerobic pond, frequently dug to a depth of three to six metres. Bill Tuttle, engineer with the City of Grande Prairie, explains that when waste is pumped into it, heavier sediments will naturally settle to the bottom.

Anaerobic ponds are deliberately dug deep to reduce the surface area of sewage open to sunlight and oxygen in the atmosphere. In the deep ponds, bacteria that can survive without the presence of oxygen and which occur naturally within sewage are activated.

The chemical processes which are involved are intricate, but basically the bacteria seek out organic compounds in the waste and feed on them. For example, a bacterium could attack a sulphate compound and detach the oxygen molecule for its own use, creating a sulphide.

(This sulphide could be hydrogen sulphide, the so-called rotten egg gas, which explains why sewage treatment at this stage can be so smelly.)

By altering the chemical makeup of suspended solids, some compounds precipitate out and settle to the bottom of the pond while others escape as gases or are given off as heat. Anaerobic treatment lasts anywhere from two days to five days and the end result is sludge precipitate beneath a black liquid with the consistency of soup.

Sewage lagoon, Mayerthorpe.

Anaerobic ponds are designed so that they can be cut off from receiving effluent every few years; the ponds are then drained and the sludge scraped away. But by and large, anaerobic ponds keep themselves clean.

For every pound of sludge that the bacteria create, 80 per cent is biodegradable and is eaten up within the pond. It just keeps getting recycled, much of it into energy or new cell mass.

After anaerobic lagoons, the waste flows into adjoining aerobic ponds where the intention is to maximize contact between the waste and oxygen in the air. Only 1.5 to two metres or so deep, aerobic ponds stimulate the growth of oxygen-dependent bacteria and algae which react with the remaining wastes and continue to transform them.

In the month-long stay in aerobic lagoons, wastes will become chemically stable and gain enough oxygen so that when released into rivers and watercourses, excessive demands on oxygen are not made from the water.

There is a very prolific growth of bacteria and algae in aerobic cells because there are so many nutrients. In fact, the contents of aerobic lagoons can attract ducks and bulrushes, and other aquatic weeds may become a problem around the edges.

In the bottom 30 centimetres or so of aerobic lagoons, some anaerobic bacteria may be active but as the waste circulates and is drawn to the top, it is purified in the upper aerobic layer of the lagoon. Because the purifying of the waste occurs in the presence of oxygen, aerobic lagoons have far fewer problems with odor.

Some municipalities have installed pipes beneath aerobic lagoons to bubble air through to encourage oxygen buildup.

Aerobic lagoons work best in summer when the sunny warm weather enhances bacterial and algal activity. But the shallowness that is their key to functioning becomes a major drawback during cold weather when activity of bacteria and algae is reduced due to low temperatures and limited light penetration through ice and snow covers.

Tuttle said the province requires that concentrations of suspended particles in treated sewage do not exceed 20 parts per million when it is discharged into waterways. Grande Prairie could likely meet that standard year-round if its aerobic pond were not iced over several months every winter.

"That's why there is some disfavor with lagoons," he said. "In the winter, the staying power declines and at times, the aerobic cell will be taken over by anaerobic action . . . In the spring when the ice comes off there's a thermal turnover and the bottom comes up to the top.

"It gets pretty smelly then."

The length of the chain of lagoons varies with the size of community being served.

Sewage lagoons, Calmar.

The one hectare of anaerobic pond needed for every 2,500 people is whittled down to one hectare per 250 users for aerobic lagoons. Grande Prairie has over 40 hectares of lagoons that can handle the current population; but the city is growing rapidly and is now looking at upgrading its facilities.

Meanwhile, Taber and Claresholm are both designing new lagoon systems for the 16,000 residents the two southern towns are expected to attract over the next few years.

Aside from the ice problem in winter, there are other shortcomings to sewage lagoon treatment systems. The method was devised on the prairies years ago when land was plentiful and people were few.

But as the price of land escalates, for towns where the land supply is limited and for centres where the volume of effluent to be treated is enormous, the lagoon system stumbles.

The province is also considering changes to legislation that will require the holding ponds at the end of a lagoon system to be able to contain one year's output of treated sewage. Grande Prairie's holding pond can accommodate seven months' worth.

The problem is that most communities that have lagoon systems do not have water courses capable of receiving treated sewage discharges on a continuous basis. Discharge of treated sewage to dry water courses during winter periods could result in icing and flooding problems, and therefore sufficient storage is required to contain all the winter's sewage. However, since the efficiency of treatment in lagoon systems is reduced during the winter period, it is desirable to hold winter flows through the summer for further treatment. This necessitates one year's storage. The lagoon would then be discharging in the fall when effluent quality is at its best. Some southern Alberta towns use sewage from the sewage plants for irrigation, thus eliminating or reducing lagoon discharges.

Tuttle said bacterial action in lagoons also can't rid sewage of detergents and metals. As a result, when released from holding ponds into rivers, a soapy froth often works up.

But despite its shortcomings, the lagoon system that's been the workhorse of sewage treatment in this province will likely be around for a long time. Once again the lagoons are dug — they need not have concrete bottoms and sides — maintenance and equipment costs are low.

"It's really not a bad system. It gives good treatment to accepted standards and is economical," said Tuttle.

Jack Spearman is a journalist in Calgary

Donald McMann

Taking The 'Waste' Out Of Wastewater

There are ways of putting it to work.

Sewage is 99 per cent water. Treatment usually removes almost all the solids it ever contained, and what's left is often an inconveniently large volume of liquid effluent.

Many communities are able to discharge their treated effluent into nearby rivers, which can absorb the remaining impurities without harm. But what options are available in cases where river discharge isn't possible?

In some Alberta municipalities, wastewater is being turned into a valuable resource.

Dr. Steve Hrudey, associate professor of civil engineering at the University of Alberta, believes we must face the fact that, though there is a lot of water in Alberta, "it isn't where the people are." In the southern part of the province, water is short; there is "an awful lot of money being spent on irrigation, and an awful lot of money being spent on fertilizer." Sewage effluent could provide both.

Hrudey's enthusiasm for wastewater irrigation is shared by Dave Graveland, head of the technical development branch of Alberta Environment's earth sciences division.

Graveland says this method of disposal not only provides a safe method for disposing of wastewater, but also is a source of the moisture and nutrients needed to improve crop yields.

Graveland has helped set up two wastewater irrigation projects in Alberta, the first 10 years ago in the small community of Granum. This modest pilot project was followed by a larger one in Taber a year later. The Taber program, according to Graveland, was the first full-scale wastewater irrigation scheme in western Canada.

This southern Alberta operation involves a two-stage process. The wastewater first undergoes a kind of advanced primary treatment using anaerobic oxygen-free cells and deep pond storage, and is then pumped from the pond to the 128-hectare irrigation site. The pumping system utilizes a 41-centimetre line to move the water up a slope, and then a 30-centimetre line to move it 1.5 kilometres to the test area. The actual irrigation is carried out by a six-wheel moveable sprinkler system. The irrigated land is owned by the community and has been used to grow feed crops. Taber's Mayor Helen Wentz is delighted with the project and says the sale of last year's crop netted nearly $20,000.

Extensive testing preceded the Taber project and has continued throughout its operation. Initial greenhouse tests, for example, were conducted to see what effects the water would have on soils and vegetation. In "greenhouse" conditions, Graveland found yield increases of from 17 to 60 per cent. He is quick to point out, however, that large differences exist between these conditions and those found on an actual site. Soil types and climatic conditions are often more significant factors when considering crop production.

In the case of Taber, the wastewater has neither improved nor harmed the soil; the improved yields seem to be solely the result of extra moisture. Data on the Taber project were gathered regularly: ground water tests were made monthly, and the soil, which reflects changes much more gradually, was tested about every two years.

The Taber experimental project has been so successful that expansion is now being planned. The storage ponds are being redesigned and will be enlarged some time in

Gas plant wastewater pond.

the next year. And a private consulting firm, after studying the facility and the town's needs, has suggested that by the year 2000 Taber should have 400 to 560 hectares under irrigation. The town's administration is currently considering these recommendations.

Wastewater irrigation is not, however, a universal answer. The use of this alternative is, says Graveland, "site specific." The determining factor is the source of a community's water. Wastewater irrigation is possible for towns with a surface water supply, but not for those dependent on underground (groundwater) sources. This is because the chemistry of groundwater — the original source of the effluent — is unsuitable for irrigation. Lack of suitable agricultural land, or a hilly location, may also rule out this kind of treatment scheme.

The U of A's Hrudey points out another problem: effluent storage in winter. He feels there's a need for more emphasis on this area of effluent management.

Nevertheless, there is growing interest in the technique. Graveland notes that at least one community each week requests information from his branch about the implementation of wastewater irrigation.

As well as small communities, industry can also dispose of wastewater by irrigation. In Alberta, many fertilizer manufacturers, gas plants, and food processors are doing so. One cheesemaker, for example, uses whey in an irrigation system. This nutrient-rich residue is not produced in large quantities, but because it is, as Graveland puts it, "such powerful stuff," it can be used sparingly and still bring about good results. Vegetable producers and meat packers are other members of the food processing industry using wastewater irrigation.

Graveland estimates that there are 25 municipal and industrial irrigation projects now operating in Alberta. Together they provide water and nutrients to some 1,200 hectares. And, he says, both the number of projects and area covered are likely to increase rapidly.

Alberta Environment is also helping launch an innovative land disposal project in the central Alberta city of Red Deer. The project involves use of an infill percolation system in which wastewater, which has undergone primary treatment, will be dispersed on to a sand or gravel soil. This kind of soil will act as a giant filter to strain out contaminants. The wastewater percolates through to the groundwater, and will eventually reach the river.

Brian Jeffers of Red Deer's engineering department explains that the system has many advantages. It provides tertiary treatment, one stage better than is now required by law, and eliminates discharge of effluent into rivers.

Planning for a pilot plant has been underway for nearly a year and is now entering the final stages. A rough estimate of initial costs is between $2 million and $2.5 million.

Jeffers explains that testing will be carried out once the project is complete, to detect any contamination of soil or groundwater. The groundwater is an especially important concern since farms and small communities obtain their drinking water from this source.

Graveland says it's expected that five or six years will be required before adequate test results are compiled. If the process is found to be both safe and efficient, he believes that up to 20 Alberta communities could make use of this kind of treatment.

Hrudey and his colleague, Dr. Dan Smith, point to other research at the University of Alberta concerned with wastewater treatment and disposal.

For example, a pilot project using ozone to help purify effluent will be carried out at Edmonton's Gold Bar wastewater treatment plant.

Wastewater treatment problems in isolated northern communities have also been examined. Smith is overseeing a project to determine possible health hazards from the disposal of greywater — all used household water excluding human wastes.

In many northern communities, permafrost makes construction of conventional sewer systems impossible — even if the money for them were available. Greywater is simply drained by pipes away from a house and on to the ground. It freezes during the winter; but when spring comes, it thaws, and children play on land that's been soaked in it. The university study is trying to find out whether the intestinal upsets, skin diseases, and ear infections so common in many of these communities are caused by water-borne bacteria circulated and recirculated in the greywater. Work is under way to find treatment methods using relatively simple technology.

Donald McMann is a journalist in Edmonton.

Jannie Stafford Edwards

Sludge Comes Out Of Storage

Pressure on land makes other alternatives important.

Sludge is the semi-solid, muddy-looking remains of successful sewage treatment.

And in one sense, the more of it there is around, the better. The more solids that can be removed from the effluent finally discharged to the environment, the cleaner the effluent will be.

The problem is that, nowadays, there *is* rather a lot of sludge around; the city of Edmonton, for instance, produces about 12,000 tonnes a year. In many cities the search for environmentally sound methods of sludge disposal is now on.

In the past, sludge from the major urban centres in the province has been trucked to storage lagoons. But as cities continue to grow, storage lagoons are filling up. With land prices escalating, sanitation officials are feeling the pressure to find alternate sludge disposal methods.

It's a juggling act of economics and environmental concerns. Each sludge disposal method — be it storage lagoons, sanitary landfill, incineration, ocean dumping or land spreading — has significant environmental consequences. Specific effects depend on what's in the sludge, as well as how and where it's disposed of.

The cleaner you make effluent, the more contaminants the sludge contains. Environmentalists are concerned about the concentrations of heavy metals, toxic organic chemicals and disease-causing organisms in the sludge.

Incinerating sludge is energy-expensive unless a viable means of energy recovery can be worked out. Some communities in the United States are considering incinerating municipal solid wastes and sewage sludge together to deal with two problems at once. But incinerating sludge poses potential air pollution problems as well as the problem of ash disposal. In addition, says David Spink, an engineer with Alberta Environment's municipal engineering branch, expensive dewatering systems would have to be installed in treatment plants to increase the solid content of sludge before it could be incinerated.

Landfilling sludge can result in leachate and runoff that could directly contaminate surface water and groundwater and thereby affect terrestrial and aquatic life. Ocean dumping has been carried on in coastal areas, but this introduces toxic substances to fish and other ocean communities and adversely affects the human food chain.

Using sewage sludge as fertilizer in land spreading programs is one disposal method that makes use of sludge as a resource. Again, there are risks as well as benefits.

On the plus side, says David McCoy, an agrologist with Alberta Environment's technical development branch, sludge is rich in nutrients needed for plant growth. Nitrogen and phosphorus are converted gradually to useable plant nutrients over a number of years. The slow-release factor makes sludge a more desirable soil additive than chemical fertilizers which are becoming increasingly expensive as energy costs continue to soar.

It costs about $68.20, for instance, to produce one tonne of anhydrous ammonia fertilizer.

Both Edmonton and Calgary now have sludge spreading programs on farm land. Sludge is trucked to fields picked by Alberta Environment soil experts and spread free of charge. Edmonton spread sludge on about 200 hectares in the second year of its sludge application pilot program last year. This used about 40 per cent of its total sludge production. Calgary spreads all its sludge, utilizing about 480 hectares of land. Officials say farmers in both areas are pleased with the programs because of time and cost savings.

In spite of the economic advantages, there are definite risks in using sludge in land applications. Heavy metals in sludge are taken out of solution when they bond with hydrogen sulphide (produced by sulphide-generating organisms that feed off organic material in the digestion process). In mineral form, the heavy metal compounds are about as insoluble as rock, and present-day technology has no way of extracting them from sludge.

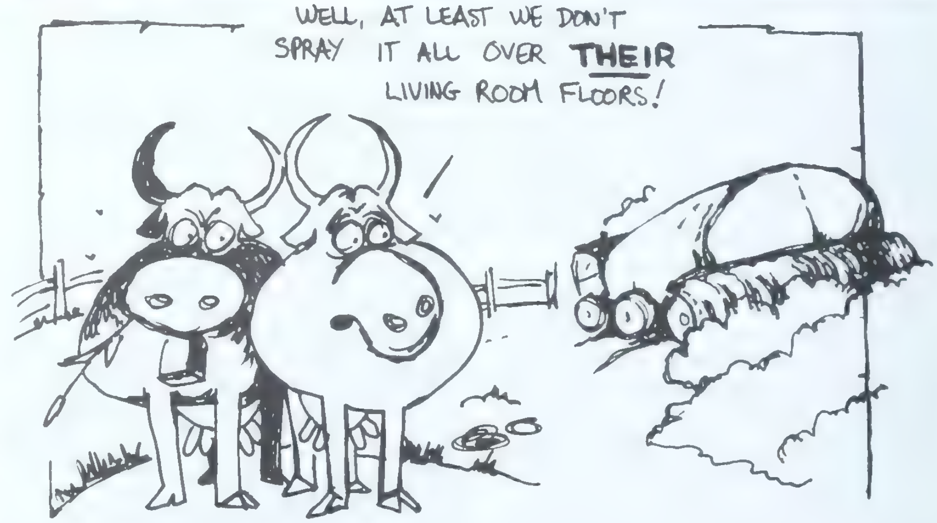
Exposure to metals such as cadmium has

been linked to cancer and, because of this link, many sludge-spreading programs are slow in gaining public acceptance. Sanitation officials are aware of the health risks and are taking measures to minimize them.

Edmonton and Calgary are taking inventories of industrial contaminant sources and surcharges are imposed on high-strength sewage wastes. According to Bob McIntosh, plant chemist at Calgary's Bonnybrook sewage treatment plant, major metal-using industries in that city have cleaned up their housekeeping systems to cut down on metal wastes and circumvent the surcharges.

Industries are the most obvious sources of metal contaminants in the sewage system. But as David McCoy notes: "Everyone has a pipe in their home, down which they can throw anything they wish." Some everyday, seemingly innocuous items are potential contaminants. Some cosmetics, for instance, are high in cadmium content.

The process of site selection and approval as well as determining sludge application rates comes under close scrutiny by Alberta Environment agrologists. "We're in the process of establishing safe parameters for sludge application while recognizing the obvious benefits of sludge as a soil additive," says McCoy. Good management practices can reduce risks.


WELL, AT LEAST WE DON'T SPRAY IT ALL OVER THEIR LIVING ROOM FLOORS!

Alberta Environment has approved a spreading rate of 23 dry tonnes of sludge per hectare, a rate about five times below the approved application rates in Winnipeg, says McCoy. Based on field experiments, agrologists feel that heavy metal and nitrate uptake into plants can be kept at safe levels with this spreading rate. Depending on soil conditions, one sludge application at these rates could be good for up to six years.

But this presents another problem. What happens when all the suitable land around a city has been treated with sludge up to safe cumulative levels? David Spink envisages a "leap frog" pumping system carrying sludge further from cities, with new pumping stations being added every five years or so. Possibly, sludge could be piped to sites where land from strip mining or tar sands operations could be reclaimed.

Site selection for sludge application

depends on soil conditions and topography. Soils at approved sites must be alkaline (at least 6.5 pH) and be able to fix heavy metals firmly in place. Acidic soils favor heavy metal uptake by plants and there is a greater risk of contaminants leaching into groundwater. Sites with steep slopes are similarly avoided to reduce risks of contaminant runoff into surface water bodies.

The choice of crops grown in sludge-treated soil also comes under Alberta Environment guidelines. "By restricting crops to cereals, oil seeds and forages, we hope to minimize metal uptake and pathogen transfer," says McCoy. Greenhouse studies carried out by Dr. Marvin Dudas at the University of Alberta found high levels of zinc and cadmium in lettuce grown in soils treated with Edmonton sludge. Other known metal-accumulating crops such as chard, spinach and tobacco are avoided, as are root crops which grow below ground.

In parts of the United States and Canada, municipal sludge is sold to private commercial enterprises that compost it and market it under various trade names. McCoy feels that consumers should be aware of the potential risks in using these products in their vegetable gardens, especially if the vegetables are consumed raw. Spink adds a similar note of caution: "Any organic matter that survives the treatment process is pretty inert, but there are no 100 per cent guarantees that all pathogenic matter has been totally destroyed," he says.

Composting as a means of stabilizing municipal wastes for land applications does, however, appear to be gaining ground in North America. The journal Compost Science/Land Utilization reports that in Europe and Japan, combination composting and resource recovery plants are common. Some of these combined operations use shredded solid garbage as a bulking agent to aid the aerobic composting process of sewage sludge. Camden, New Jersey, now composts all of its sludge in a recently constructed $2 million facility. Other major cities reported to be looking seriously at the composting alternative include Boston, Washington, D.C., Windsor, Ontario and New York City.

Earthworm composting (vermicomposting) on a community-sized scale is another interesting alternative for sludge disposal. The burrowing activity of earthworms makes them natural aerators and shredders. They promote stabilization, reduce odors and manufacture substances similar to growth hormones in plants.

The city of Lufkin, Texas, is reported to be planning the first municipal vermicomposting facility on this continent. As currently planned, the facility will use 22,220 kilograms of worms to process over 40,000 litres per day of sludge.

The search for economically feasible and environmentally safe methods of sludge disposal continues.

Jannie Stafford Edwards is a freelance writer living in Edmonton

Susan Mayse

The history of sewage treatment in Edmonton has been

A Scramble To Keep Ahead

E. Brown Collection, Provincial Archives of Alberta

Turn-of-the-century Edmonton and the North Saskatchewan River.

In 1907 Edmonton was booming. Legislative buildings sprang up near old Fort Edmonton, businesses mushroomed to serve new arrivals, while across the muddy North Saskatchewan a university and the CPR line from Calgary swarmed with construction workers. Every train disgorged another load of newcomers with their bundles and bright hopes, and every rain turned Jasper Avenue into a five-kilometre mudhole swallowing draft horses to the girth.

Draft horses, it turned out, were the last straw for sanitation. The new public health department passed one of its first regulations: to avoid sewage contamination of drinking water, construction camps must locate their men's quarters upstream from the stables.

Soon after, the first step toward civic water and sewage treatment in Alberta's new capital was taken — by the CPR, as rail gangs pushed track north across the ultra-modern High Level bridge (two hay wagons wide!) to the Edmonton terminus. City population doubled and tripled. Backyard privy and open storm sewers could no longer handle Edmonton's waste disposal. Around 1915 the railway build Number One treatment plant at the foot of 101st Street, using methods essentially the same as today's. The activated sludge plant kept the sewage in constant motion until suspended solids settled out, and the remaining water was channelled back into the North Saskatchewan, a river where youngsters still swam in summer and many families drew their drinking water.

E. Brown Collection, Provincial Archives of Alberta

"Sewage treatment started very early in Edmonton," says Bob Dilke of the city's water and sanitation department. "It was a concern."

Following decades saw a boom-and-bust cycle in northern Alberta, and a succession of Edmonton sewage treatment facilities. Each was designed to meet the needs of the growing centre well into the future. But Edmonton's population grew at an unimaginable rate, from 700 residents in 1891 — to 14,088 in 1906 — to 72,516 in 1914, finally levelling off through the '20s with about 80,000. Generous long-range estimates of population growth, then a sudden scramble to keep ahead: that sums up the history of sanitation in Edmonton.

Rat Creek plant near the present Dawson bridge supplemented the first facility in the early '20s. Ten years later, another below Queen Elizabeth Park expanded the system again. A fourth plant at the foot of Mill Creek was yet another attempt to treat water and sewage before returning it to the river.

"All of them were good plants for their day, and for the technology of their day," says Dilke. "But there was a lapse in the early '50s. Edmonton grew and the plants were overloaded. Back then, when you talked about laying out $2 million for a new treatment plant, you might as well have been talking about bringing down the sky. The money wasn't available."

Much of the sewage was bypassing the plants entirely because of a combined sewer system: storm, residential and industrial sewers ran together into the treatment plants. Normally the facilities could handle the volume, but storms routinely meant a huge overflow.

"I worked out figures for one heavy storm — our normal flow was about 55 million gallons a day. The storm produced 1,500 million gallons a day. You can't reasonably expect to treat that volume."

The broad North Saskatchewan often suffered the consequences. Fish died, the river became murkily discolored with a white lime streak down the middle from the water treatment plant. More than 640 kilometres downstream in North Battleford and Prince Albert, the next towns drawing their water supply from the river, the color, odor and chemical content of tapwater were offensive. A 1953 sampling showed effluents dumped by the Canadian Chemical Company were responsible for much of the pollution. The rest was due to Edmonton's location and climate.

Lauren Dale

Gold Bar plant secondary sedimentation tanks.

Oxygen depletion was the main problem. Winter ice cover prevented the running water from re-aerating itself through constant motion and the play of winds across the surface. Ice was much like a plastic bag over the river, suffocating it. Without natural re-aeration to replenish the oxygen used by bacteria to break down the biological-oxygen-demanding (BOD) substances in the sewage effluent, a river quickly becomes septic, and foul to sight and smell.

In 1957 a new treatment plant began operation at Gold Bar, fed by sewage from pump wells and sewers which replaced plants at the four earlier sites. A 1969 addition kept pace with the city's growth, and a further expansion to begin operation in summer 1980 will more than double the plant's volume.

"The plant has been handling about 450 megalitres a day through the primary process and about 225 megalitres through the secondary process," says Gold Bar lab director Glen Brown. "It is now being expanded to handle 1,100 megalitres in primary treatment and 325 in secondary."

Raw sewage arrives in the plant from across the city, and divides into three streams. Each sluices through a grit tank where air continually bubbles to keep organic matter in suspension. Every day about a cubic metre of inorganic material such as sand and silt settles out. This is hauled away as sanitary landfill when the tanks are drained periodically. Large industrial and residential wastes, euphemistically called "rags" but consisting mainly of unsavory packing plant offal, are also screened off at this stage.

Primary settling tanks are the next destination. Organic solids settle out, and are piped into five huge anaerobic digester tanks where organisms active in oxygen-free environments go to work. They degrade the organic matter, in the process generating "digester gas" (mainly methane and hydrogen sulphide) which fuels the facility's heating system. The solids are pumped to storage lagoons outside town; there is also an experiment in applying the sludge as farmland fertilizer.

Meanwhile the effluent carries on to secondary treatment, and mixes with "biological sludge" containing millions of micro-organisms which feed on the effluent's organic matter. After about three hours in motion, the solids are recycled to act as biological sludge for the next batch, and the effluent is channelled back into the North Saskatchewan River.

About 90 per cent of the suspended solids are normally removed by the process — well within Alberta Environment's 85-per-cent limitations — except during plant difficulties. From December 1979 to spring 1980 the Gold Bar plant removed only about 83 per cent while staff struggled to correct the problem.

Two lagoons supplement the city plant: a sludge storage lagoon at Clover Bar, and an industrial lagoon at Bremner which processes high-BOD wastes from two large packing plants as well as residential sewage from Sherwood Park and Beverly. Quality of the water released back into the river every summer varies from the Gold Bar plant's level to a less satisfactory removal rate. It's the best the Bremner lagoon can manage, and while the province accepts it for the present, talk is afoot about a conventional activated sludge plant to replace the lagoon.

The North Saskatchewan lacks some problems such as the weed growth that plagues Calgary's clear-running Bow River. The frequently muddy North Saskatchewan filters the sunlight, preventing the unsightly weed growth which depletes oxygen when it decomposes in fall.

Edmonton is considered to do a very good job of treating sewage — and to produce an environmentally acceptable effluent.

But the city is projected to double to about a million residents by 2005. Will the

Lauren Dale

Gold Bar expansion and replacement of the Bremner lagoon really head off population growth and more stringent environmental regulations? Or will the North Saskatchewan eventually become an open sewer?

Tertiary treatment offers one possible solution. By chemical addition to remove BOD material, or by filtration of all effluent after its secondary treatment, water could be reintroduced into the North Saskatchewan in a purer state. As always, there's a price to pay.

A tertiary treatment installation for Edmonton could double the capital cost of the Gold Bar plant, now about $80 million, without calculating increased operating costs.

"I haven't seen anything to justify the cost at present of additional treatment," says Dilke. "If we're called upon to put out $30 or $40 million for an additional sewage treatment plant, we'd like to see a good reason for it. The province can order us to do anything they want — we are their step-child."

He cited the provincial order to recycle lime used in water treatment rather than returning it to the river where it created a highly-visible white streak. Edmonton has built a $6 million plant to process the recovered lime, and now it costs about $100 a tonne to produce instead of $55 a tonne to purchase elsewhere — a high price for aesthetic pollution. Lime is almost inert, Dilke says, and has almost no effect on the river's health.

While Alberta, operating its own grant program and administering a federal program, can underwrite sewage and water treatment projects in smaller centres, only limited money is available for Edmonton and Calgary. Yet the provincial government can require upgrading or additions to treatment plants at city expense. It's one aspect of a somewhat uneasy relationship between provincial and city governments, between different provincial governments, between sanitation departments and the industrial complexes which contribute to the sewer-carried waste load.

"We've been hearing about zero discharge, recycling all sewage," Dilke says. "It is possible — but people tend to think it's only a matter of money to bring it about. Money is energy and energy is pollution. Every dollar we spend creates some kind of pollution — if we add another $100 million plant here we've created $100 million of pollution in wastes from a steel mill in Hamilton, or smoke going into the air."

A more attainable control measure could be limiting the industrial input to the sewer system. Heavy metals and industrial chemicals represent a greater threat to human health than even the high-BOD materials from packing plants and residential sewage, and also threaten the river's health.

That means more provincial controls, either directly on industry or indirectly through municipal bylaws, to require onsite treatment of water and sewage. Whether the price is hard cash or hard words between all interests in waste disposal, ultimately Edmontonians and their river bear the cost.

Susan Mayse is a freelance writer living in Edmonton.

Elaine Park

The Battle Of The Bow

Until recently, the weeds were winning.

Settling pond, Bonnybrook sewage treatment plant.

[illegible] Calgary Herald

As the Bow River passes through Calgary, it undergoes an unpleasant change in character.

What flows into the north-west outskirts of the city as a clean, clear-flowing stream fresh from mountain glaciers, flows out the south-east boundary as a frequently weed-choked waterway. Large masses of brilliant green weeds are rooted to the bottom of the river during the summer months.

This degeneration in the river is evidence of a process known as cultural eutrophication — the fertilization of surface waters with plant nutrients as a result of human activity.

Eutrophication can occur in nature when surface water bodies are surrounded by naturally productive land. The water gradually becomes enriched with the minerals necessary for aquatic plant growth, plants take hold and thrive, all levels in the food chain above them become more productive, and the nature of the lake ecosystems eventually changes. Such natural eutrophication is, however, a very slow process.

Cultural eutrophication, in contrast, produces a rapid increase in plant growth that places stress on the other elements of the aquatic environment. Levels of dissolved oxygen in the water begin fluctuating, and many clear-water life forms have difficulty surviving.

The weeds in the Bow below Calgary have been a worsening problem for a number of years. Recently, they became a nuisance of such proportions that Alberta Environment and the City of Calgary began searching for ways to reduce the organic pollution that feeds the plants.

Now there is hope that a combination of research and applied sewage treatment technology may lead to an improvement in Bow water quality by the middle of the 1980s.

The campaign to clean up the Bow had its first push forward in 1976, a year in which the bloom of algae in the South Saskatchewan river system (of which the Bow is a part) was prolific and many members of the public lodged complaints with Alberta Environment.

Fishermen warned that the reach of river from Calgary to the Blackfoot Reserve, once world-famous as a trout fishery, was deteriorating to the point where large fish-kills could be expected. The weeds were doing additional damage by plugging the intakes of two fish ladders designed to permit the trout and whitefish of the Bow to reach their upstream spawning grounds.

Farmers and ranchers in the South Saskatchewan river system who rely on rivers for their irrigation water complained to the government that drifting filaments of algae were blocking the valves and pumps of their irrigation systems. Alberta Agriculture investigated and estimated that the river's organic pollution caused a loss of about $600,000 in 1976 to irrigating landowners in the region.

The City of Medicine Hat reported that it had to install new flushing equipment in its water intakes, hire extra labor to keep the pumps cleaned out, and use chemical treatments to reduce offensive tastes and odors caused by winter-time decay of plant materials. Municipal officials claimed it was getting more difficult and expensive every

Alger (left), Cookson, and Zaozirny tour the Bow's problem area.

Terry Cion · Calgary Herald

year to make river water fit for household use.

The complaints were so many and varied that Alberta Environment's water quality control branch began to investigate them. Calgary water quality biologist Klaus Exner documented the effects of organic pollution on recreation, irrigation, and municipal water systems, and estimated that in 1976, direct costs attributable to excessive filamentous algae growth were about $1 million in the area from the confluence of the Oldman and the Bow to the Saskatchewan border.

He identified the trouble-making weed as algae of the genus Cladophora, a plant that takes root easily on the rocky bottoms of swift streams. It grows quickly, putting out branched filaments that sometimes reach two metres in length. The snake-like branches tend to break off in the strong current and float downstream to foul reservoirs and water pumps.

Exner's report, completed in 1977, indicated the scope of cultural eutrophication in the South Saskatchewan river system and suggested possible causes of the excessive weed growth.

The nutrients known to produce rich Cladophora growth are phosphorus and nitrogen. Testing above Calgary showed minimal levels of phosphorus, but sites downstream at Bassano, Carseland and the Bow mouth frequently yielded readings in excess of .06 to .07 milligrams of dissolved phosphorus per litre, levels known to correlate directly with optimum Cladophora growth.

The report identified the largest point source of phosphorus as the Calgary sewage treatment plants which were pumping about 320 tonnes of phosphorus into the river annually.

The presence of nutrients alone was not enough to cause weed growth, Exner concluded. A high nutrient level had to be combined with a sunny growing period and a light spring scour of the river bottom for maximum plant growth to occur. Yet, given the necessary climate and river conditions, the presence of the man-made nutrients made organic pollution a certainty.

The water quality control branch drew up a proposal for a large-scale, four-year monitoring and research project to investigate means of controlling cultural eutrophication in the entire South Saskatchewan river basin, and kept watch on the Bow throughout 1978. That year weed growth at some locations reached almost 40 tonnes of plants per kilometre of river, and laboratory experiments on river water samples showed that water downstream from Calgary could support 100 times more weed growth than water from immediately above the city.

In January, 1979, the four-year study was launched. The plan included water, plant and sediment sampling; laboratory experiments to determine the effect of different environmental factors on plant growth; a feasibility and cost/benefit study of phosphorus reduction; and an assessment of benefits from control of nuisance plant growth.

"Basically, the water quality control branch is taking upon itself the justification of phosphate removal," says Exner. "We know that nitrogen also nourishes the plants, but phosphorus is the nutrient of focus for three reasons: experiments have shown that when we remove phosphorus, the growth of the plants is reduced, regardless of how much nitrogen is present; the technology of phosphorus removal is already well established while that of nitrogen removal is not; and phosphorus has no atmospheric phase."

Having focussed on phosphorus, the water quality control branch began a massive piece of detective work.

"The first thing we had to do was find out exactly what the relative contributions of phosphorus from various sources were," Exner says. "During 1979, we set out to measure inputs from both point and diffuse sources."

Besides conducting a rigorous sampling program at selected sites along the Bow, Oldman and South Saskatchewan river channels, water quality control branch and city personnel had to head into the wind and rain when summer storms broke, in an attempt to measure the contribution of urban storm sewers to the nutrient loading of the rivers.

Initial results of the measurement program show that nearly 70 per cent of the total phosphorus entering the Bow from Calgary to the confluence with the Oldman comes from the Calgary storm and sanitary sewer systems, with the sewage

Canals carrying final Bonnybrook effluent to the Bow.

Garth Pritchard, Calgary Herald

treatment plant alone contributing 50 per cent of that total.

In addition, the testing indicated that phosphorus produced by the treatment plants is largely orthophosphate, a form of the mineral readily taken up by plants. Most of the remaining phosphorus load is in particulate form, and has little fertilizing effect on river plants.

"A source frequently touted as causing phosphorus loading is agricultural activity along a waterway," says Exner. "But agronomists have known for years that phosphorus does not readily migrate through the soil profile and find its way back to surface water by way of groundwater. Indeed, our measurements show that on the whole irrigation returns do not contribute a large loading of phosphorus to the main stem rivers. Collectively they account for less than five per cent of the total phosphorus load."

Although the sewage treatment plants emerge from the initial study results as the prime contributors to organic pollution in the Bow, Calgary cannot be blamed, says Exner.

"It's not fair to point an accusing finger at the City," he says. "The City operates its plants as well as anyone in the province, within existing guidelines laid down by the department of the environment. It's up to the department to formulate new standards for phosphate removal, once the implementation of that technology has been justified."

While the South Saskatchewan River Basin Eutrophication Control Study was getting underway, a number of concerned individuals and groups decided during 1979 that they couldn't wait for the outcome of the scientific investigation. They argued that the causes and consequences of organic pollution in the Bow were plain enough to warrant an immediate clean-up.

Calgary newspapers and electronic media publicized the condition of the river, and southern Alberta fishermen made strong presentations to a select committee of the legislature on the need for quick action to preserve the river as a fishery.

Public pressure began building, and in August, Calgary Mayor Ross Alger, Environment Minister Jack Cookson and Forest Lawn MLA John Zaozirny took a boat ride down the Bow past the sewage outlets to inspect the weeds. Alger and Zaozirny urged that the province take action.

By the end of the year, a directive had come from the minister of the environment instructing the city to begin removing phosphorus from its sewage by the beginning of 1983. The start-up of treatment will coincide with the end of the water quality control branch research.

The likely method of phosphorus removal will be the addition of liquid alum to wastewater in the final settling tanks, according to E.W. Meckelborg, sewer treatment engineer at the Bonnybrook sewage treatment plant.

The plant is about to undergo an expansion to more than double its capacity to 450,000 cubic metres per day. The phosphorus removal equipment is expected to add about $14 million to the cost of the expansion, and the annual cost of the alum for the process is expected to climb from $1 million in 1983 to $2 million by 1993.

Meckelborg says the main source of the phosphate in Calgary's sewage effluent is human and household waste.

"The best place to take out the phosphorus is here at the plant," he explains. "Since the regulations reducing the levels of phosphate in laundry detergent came into effect in the early 1970s, there has been little an individual conservationist householder can do to reduce his own phosphorus output further."

Meckelborg estimates that 25 per cent more sludge will be formed by the addition of phosphate removal to the other treatment processes. The sludge is shipped from Bonnybrook to the Shepard sludge lagoons and distributed free of charge to area farmers who use it as fertilizer.

The cultural eutrophication of the Bow River at Calgary has pointed out the need for study of nutrient loads in all provincial waterways. Although the problems of the Bow are uniquely acute, the possibility of similar organic pollution developing downstream from other urban centres cannot be ignored. At the time this article was written, a cabinet committee was considering recommendations from Alberta Environment dealing with province-wide nutrient-control standards and possible methods of funding municipal nutrient removal projects.

Elaine Park is a freelance writer living in Calgary

Brian Tucker

Planning For Growth

Communities can't expand if sewage treatment facilities are inadequate.

Sewage treatment is hardly a topic guaranteed to arouse civic pride — a new sewage plant doesn't rate a parade down main street.

Yet a town's growth can be paralyzed without an adequate sewage facility.

When a development project is being planned, Alberta Environment can recommend adequate sewage facilities be included in the plans. And later, when the project is ready to be started, the department can halt construction by refusing to issue a permit if sewage facilities aren't good enough.

About $50 million a year is spent in the province on new sewage facilities, ranging from septic tanks to multi-million-dollar treatment plants.

Small communities usually can't afford sophisticated sewage treatment. Good examples are the hamlets of Canyon Creek, Widewater and Wagner on the south shore of Lesser Slave Lake.

Size, location and topography are all against the hamlets, says Len Kruger, manager of improvement district 107 in High Prairie.

Their combined population is about 400, making their tax base too narrow to support a complex sewage disposal system. They're 11 kilometres apart, making the cost of linking them by sewer line prohibitive. And they're surrounded by hills, adding the extra cost of lifting stations.

"We've been crying for the last two or three years for water and sewage facilities," says Denny Garratt, president of the Canyon Creek-Widewater community association, the hamlets' political voice.

Residents have been getting by with pit toilets and septic tanks mostly. Many use a system in which pipes distribute the effluent from the septic tanks into the soil. In many places the soil has become saturated; sewage runoff has polluted the water supply in some cases (by raising the nitrate content) and has seeped into the lake.

The communities took their complaints to the municipal affairs department, which then hired an engineering firm to do a study. The study recommended a water and sewage system, including a series of lifting stations, water treatment plant and sewage lagoon, that would cost $4.2 million.

Andrew Vaughan

Denny Garratt

"That's totally out of the picture financially," says Garratt. So the local improvement district 17 and municipal affairs are studying alternatives in funding and scaled-down systems.

The best the hamlets can hope for is a water treatment plant and a main sewer line between Canyon Creek and Widewater, says Kruger.

In their hunt for a cheaper alternative, the hamlets have received approval from Slave Lake to use its sewage lagoon. They've also asked the local improvement district to share the cost of trucking the raw sewage to the Slave Lake facility. It may cost $60,000 a year, including the purchase of a truck, says Garratt.

He predicts the hamlets will grow, because the town of Slave Lake has a limited area in which to expand and the scenic lakefront is attractive to cottagers.

"We're 99 per cent in favor of water and sewage facilities. And we're realistic we're not going to grow without them."

The hamlets would probably envy Carstairs, a community of 1,600 about 50 kilometres north of Calgary. The town's new $2.5-million sewage lagoon will be completed by summer. But not everyone in Carstairs is pleased about it.

Two landowners opposed the town's choice of a site; another two fought having a strip of their land used for a right-of-way for the sewer line. They were backed by other farmers concerned about the loss of agricultural land.

Harold Winger, who owned 19 hectares of the 40-hectare site, said about 140 people, including about 120 farmers, showed up at one meeting in the town. "A lot of farmers in the area felt it was a foolish undertaking, too expensive," says Winger.

A lagoon is the most common type of sewage disposal facility in the province — about 70 per cent of municipalities use them.

About three years ago, Carstairs' existing lagoon system reached its capacity. Alberta Environment then said any development that had already started could continue, but no new subdivisions would be allowed.

"The town had the choice of lying dormant or building a new system," says Walter Guest, a consultant for Engineering Canada, the Calgary-based firm hired to study sewage treatment options for the town. The firm recommended building a sewage lagoon three kilometres east of the town. The site allowed room for a sewage treatment plant when the town's population reaches 5,000.

Guest says half the site was slough and unsuitable for farming. Other sites would have robbed land that was 100-per-cent useable for agriculture. "This site was felt to be ideal, it took less land out of cultivation."

Winger denies the land was slough. He says the land sometimes flooded — in the spring after heavy winter snowfall — but that it could be productive if it was drained.

"There was two feet of top black soil in the area. It could have been more productive than any land around."

Winger wanted a sewage plant built at the old site in the town, because he says it would have used up less land. And he believes sewage lagoons don't do as good a job of breaking down sewage as a mechanical plant.

"We should be going to a mechanical system, not an old-fashioned lagoon system. We've got pretty good water in Alberta, but it's not going to stay that way unless we start to protect it."

David Spink, an engineer in Alberta Environment's municipal engineering branch, says sewage lagoons can produce a better quality of effluent than sewage plants, provided the lagoons are properly designed and operated, and special care is taken to discharge effluent at the right times.

Mayor Charles Brinton says the town rejected a plant because it would be too costly to run. A lagoon is cheap to maintain — all you have to do is inspect it once a week and "mow the grass on the embankment," says Guest. A plant, however, requires staff and repairs of machinery.

Because plants release effluent every day, they ideally should be on a river so the effluent can be flushed away easily, says Brinton. There are no rivers nearby, only creeks that are dry most of the year.

"We shied away from a plant because we still couldn't get along without a lagoon," although the lagoon required would be smaller.

Building on the old site, within the town boundaries, would also restrict the growth of Carstairs, the mayor says. You can't build within 300 metres of lagoons, so the land would be "frozen" for development.

The cash settlement proposed by the town upset Winger. "They don't want to pay me for the resale value of my property. It's prime land. Ten years from now it's going to be worth 10 times as much."

A sewage lagoon would lower the value of his land, he says.

Brinton says the town first offered $1,000 an acre ($400 a hectare) — the appraised value plus a few hundred dollars for the farmer's inconvenience. The farmers asked for four times that, so the town raised its offer to $800.

Andrew Vaughan

Eventually, the town dropped its offer to $400, paving the way for a provincial agency called the lands compensation board to decide on a fair price after the farmers launched an appeal.

While the sewage lagoon is about 90-percent built, the legal battle over whether the town had the authority to go ahead with construction continues. The town expropriated the land and received approval for the project from Alberta Environment.

The farmers went to the county's development appeal board, alleging the town should have had a development permit from the county before construction started.

Recently, the permit was approved after the fact, with conditions attached that covered some concerns raised by the farmers.

For example, the farmers believed the base of the lagoon wasn't properly sealed and posed a pollution threat to wells in the area. So the permit included a condition that the lagoon would be properly sealed and the two wells most vulnerable to a pollution threat be closely monitored by Alberta Environment.

A local problem of handling sewage from restaurants, motels and gas stations along Highway 2 south of Red Deer grew into a plan for a regional system.

"Some of the companies wanted to expand, but they couldn't get permits without better sewage facilities," says Bob Stonehouse, administrator of the County of Red Deer.

Alberta Environment suggested that the county look at a regional system, to include Penhold, the Canadian Forces Base at Penhold and Red Deer Industrial Airport.

Penhold's sewage is now treated at the air base four kilometres away. But that system is near capacity.

"We feel we can't allow any further development until our sewage treatment is better," says Florence Long, village administrator. If the town built its own facility, it would have to hire staff to run it. And "people are not anxious to have a sewage lagoon in their area. There would be a lot of opposition."

The county has come up with two options: build its own plant that would empty into the Red Deer River about 11 kilometres upstream from Red Deer, or tie into Red Deer's plant, where a $23-million expansion is about to start.

If the county built a plant upstream from Red Deer, more stringent treatment standards would be required, says Ken Armstrong, an engineer with Reid Crowther and Partners Limited in Red Deer, hired by the county to study the problem. This would add to the cost of the treatment plant.

So the option of a link with the Red Deer system seems the most likely one. The county would like to have its trunk lines built by 1982, when the plant expansion will be completed.

The proposal is only in its early stages, with technical issues having been discussed by engineers and administrators. Politicians from Red Deer and the county will have to

Housing development at Stony Plain.

Lauren Dale

decide on such issues as how to share the cost of the new system and a rate structure agreement.

The county is studying the possibility of having part of the Red Deer plant expansion set aside for its use. That would mean sharing the cost of expansion, which calls for the plant's capacity to be tripled to 12 million gallons a day.

The county would like to start construction on the sewer lines by early summer. Tenders for the plant expansion will be let likely in May.

With any regional system, there are tradeoffs. The county may be giving up some of its autonomy over future development, by relying on Red Deer for sewage treatment.

Stonehouse says the county is aware of that danger. But "if we bought part of the plant, I don't see any problem, because we would own that part and the lines going into it."

Red Deer, meanwhile, must consider what is best in the long run. The plant is designed to last 10 to 15 years, and Red Deer may have to look at expanding earlier than that if it gives up part of the plant's capacity to the county.

"I don't foresee any great controversy," says Brian Jeffers, a City of Red Deer engineer. "We're not at loggerheads. It's just a matter of ironing out some details."

Stony Plain is also looking at a regional system. The town 20 kilometres west of Edmonton is in a region with one of the fastest-growing populations in Canada.

This type of rapid growth has almost overtaken the town's sewage system, says Wayne Anderson, town manager.

Ten years ago, Stony Plain had 500 people. Now the town has 4,000 people and very soon will have 5,500 — the population its current sewage lagoon northeast of the town was designed to serve.

With land at a premium, the option of expanding the town's existing lagoon seems unattractive. The lagoon, now on 56 hectares, would need to be three times as big to meet the needs of the projected population of 15,000 in 2005, says Gene Luchka, engineer with Associated Engineering Services Ltd., the consulting firm working for Stony Plain. There is also the advantage of transferring the costs of maintenance and staff to one regional plant.

There are also environmental concerns. Stony Plain now empties treated effluent from its sewage lagoon once a year into Atim Creek, part of the Sturgeon River basin.

Murray Ellis, an engineer in Alberta Environment's municipal engineering branch, says the basin doesn't have the capacity to handle the effluent. The creek already floods after cloudbursts and spring runoff. If the runoff contained sewage, there would be the danger of dumping polluted water on farmland.

Stony Plain was included in the 1978 Edmonton Regional Utilities Study, which reviewed the water supply and sewage disposal needs of the entire Edmonton region.

The study said the cheapest option was to have smaller communities such as Stony Plain build their own sewage systems.

However, environmental concerns led the study to recommend Stony Plain, Spruce Grove and Morinville be linked to a regional system. The study urges all communities within a 15- to 20-kilometre radius of Edmonton should be served eventually either by a new regional plant that would empty effluent downstream from Edmonton into the North Saskatchewan River, or the Gold Bar plant in Edmonton.

The provincial government likes the idea of the regional plant and has ordered studies of how much it would cost. A report is expected in June.

Stony Plain is negotiating with the County of Parkland, Spruce Grove and Morinville to join in building a sewer line into either the St. Albert sewage system, the proposed regional system or Edmonton's sewage system. Associated Engineering hopes to report to the town in June.

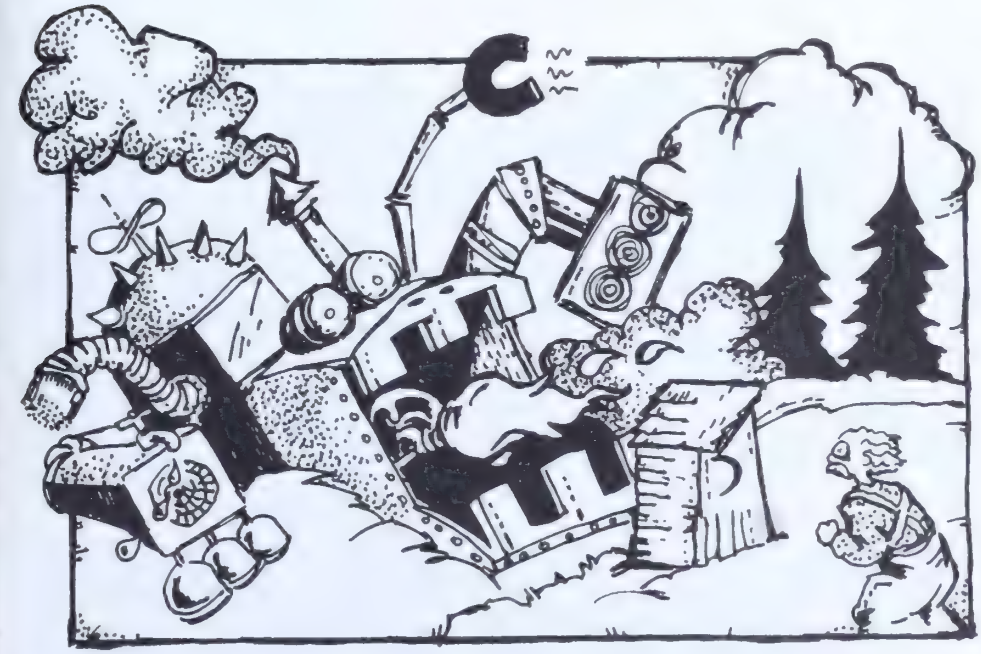
The municipalities face some obstacles whichever route they choose, Ellis says. For example, if they link with Edmonton's system, could that city's sewer lines handle the extra load? If not, they would have to pay to build sewer lines through Edmonton to the Gold Bar plant in the east end. This would cost more than to build a line through a rural area.

Brian Tucker is a journalist in Edmonton

Sharon Adams

Individual Sewage Systems

There are several sewerless options available.



In areas of concentrated population, large sewage treatment and handling systems have been developed to help man deal with the management of his own wastes.

But what happens in areas where population doesn't warrant a large system, where distance between homes is great, where a water shortage precludes use of the standard flush system, or where occupancy is seasonal?

There are several basic and well-known on-site waste management systems. The pit toilet (backhouse or outhouse to the layman) is perhaps most familiar, if not most romantic. The septic tank and accompanying weeping tile field and/or cess pool is probably the most used system outside urban centres in Alberta.

And in response to the energy crisis, water shortages and a growing environmental conscience, a number of biological waste treatment alternatives are being developed for individual use.

The prime rationale for having sewage collection and treatment systems at all is to ensure sewage and effluents do not contaminate potable water.

Each system mentioned — pit toilets, septic tanks and biological toilets — offers advantages for sewage handling and poses its unique problems.

Although many rural landholders, particularly those in remote areas, use pit toilets, the provincial parks system likely has had the most experience with them.

Bruce Duffin, operational planning coordinator for Alberta Parks and Recreation, says pit toilets, with their biodegradable action, are ideal for remote, infrequently-used toilets.

But they are inadequate in areas of heavy use where their composting action, which breaks sewage down over a period of time into humus, cannot keep up with demand.

In addition, he says, the composting action takes place in a well-defined temperature range; in wilderness areas where the outside temperature can lower to near freezing point even in summer, the temperature drop could retard the biological breakdown of the compost.

He says the department carefully chooses sites for pit toilets so sewage or effluent cannot contaminate drinking wells or nearby water bodies, and tests are done to ensure a margin of safety between the pit and the water table.

When the pits become full, the department simply covers in the pits and relocates the toilets at a site some distance away so as not to overload the nearby environment.

In areas of higher use, however, the parks department has installed vault toilets. While the user probably wouldn't notice a difference, vault toilets do not break down the waste, but simply act as storage tanks. When the plastic, fibreglass, steel or concrete vaults become full a tanker truck removes the waste and transports it to sewage lagoon or treatment plant.

For householders, pit toilets present two other problems: not only must lots be large enough to accommodate a change of site when the pit becomes full, but a system to dispose of kitchen, bath and wash water is still needed. Loaded with greases and detergents, this so-called "greywater" presents its own disposal problems and can contaminate groundwater as easily as sewage.

Householders with pit toilets likely also have a septic tank to handle the greywater, but most rural septic tank owners use the system for sewage.

Located on site, with proper installation to avoid contamination problems and infrequent maintenance, septic tanks once seemed the ideal solution to individual waste management.

The average tank is of about 3,800-litre capacity and measures about 2.5 by 1.2 by 1.2 metres. Sewage and greywater from a house pour into the septic tank where the solid material settles out. The effluent then travels into a weeping tile field — interconnected subterranean rows of trenches where the effluent evaporates or leaches into the ground.

In areas where the soil is not absorbent and the effluent must all be evaporated, cess pools or evaporation mounds, which allow evaporation from the sides as well as the top, are added at the end of the weeping tile field.

When the septic tank fills with solids, waste is removed by a tanker truck to the nearest processing plant or sewage lagoon for treatment.

But modern lifestyles have been the

Rural dwellers and lakeside cottagers make most use of individual sewage systems.

Lauren Dale

undoing of many a septic system.

Chief inspector W.A. Milligan, of Alberta Labor's plumbing inspection branch, says many systems, particularly the older ones, cannot handle the amount of water being put into them.

The result is that the raw sewage or effluent begins to come to the surface of the ground, creating a health problem.

Most systems were adequate in their day. "Ten years ago people used 37 to 40 gallons (180 to 200 litres) each per day. Now it's up to 65 to 70 gallons (300 to 340 litres) each per day. Systems still in use which were designed to handle 40 gallons each per day will overload."

The major culprit, he says, is the modern washing machine, which uses more water; but lifestyle and expectation has a lot to do with the use of water. People have become urbanized, unused to thinking about what happens to the stuff they put down drains or what happens once the toilet is flushed.

Alberta Environment's regional land use branch and Alberta Labor's plumbing inspection branch collaborate to ensure the most effective system is chosen for new residences or vacation properties, but there's little to be done about an old inadequate system until it fails.

And that presents another problem.

Milligan says many lots, especially older ones, are too small to accommodate everything that has to go on them.

Although the minimum lot size has increased from 450 to 1,800 square metres, many have irregular terrain and just can't accommodate a dwelling, a garage or carport and a well and have enough room left over for a septic tank and weeping tile field to be located an acceptable distance away from the drinking water supply and far enough above the water table to pose no problem to nearby water systems.

Fred Schulte, head of Alberta Environment's regional land use branch, says good planning can overcome some of the problems.

"Our philosophy is the land should be capable of supporting everything that has to go on it — water and amenities — and should make it possible for sewage to be disposed of on the same site."

He says his branch becomes involved in initial subdivision approval stages, but leaves the nitty-gritty work to the plumbing inspection branch.

The branch looks over each application for subdivision with an eye to minimizing chances of sewage contamination. It does water table tests to determine site-specific soil conditions; sets out requirements for a buffer system between high water marks of nearby water systems and the edge of the lot; and establishes the best setback requirements for the soil conditions present.

Lew Goddard, supervisor of environmental health services for the Leduc-Strathcona health unit, says bad planning has caused "all kinds of problems."

Not only do the older septic tanks and leach fields flood because homeowners insist on putting too much water through them, but people don't properly maintain the trenches; or they run their recreation vehicles or other machinery over the field, compacting the earth and making it impossible for the field to absorb effluent.

When a system fails the health unit can declare it a health nuisance and order the field to be fixed. If the owner doesn't comply, he could eventually end up in court.

The health unit in his area holds an informal hearing attended by the property owner, health officials and a representative of the plumbing inspection branch. The owner is asked to tell how he proposes fixing the problem and can call on the expertise of attending officials.

Provincial officials have little to say about the new individual on-site sewage systems being developed primarily in the United States to assuage energy or environmental concerns.

The systems, often still in the development stage, use a number of operating principles and include systems which break down the waste biologically, incinerate waste to produce a sterile ash for disposal or allow circulating fluid to be sterilized and reused in the system.

Jorg Ostrowski, of Sunergy Systems, says the major disadvantage to the large composting toilets is psychological.

"People don't want to believe they work, that they don't smell," he says.

A composting toilet is simply a large fibreglass chamber, usually located in a basement, with a 30-degree sloping floor. Human waste from the toilet and organic kitchen waste drop through a chute into the chamber where micro-organisms slowly break down the material into soil-enriching compost.

After three to five years, Ostrowski says, the material will be completely broken down and any harmful bacteria eliminated. The householder simply takes a bucket or two of compost from a special holding chamber for use in his garden or greenhouse.

The system uses no water and can save householders 192,000 to 240,000 litres of drinking water annually — a big plus in areas in the southeastern part of the province where water has to be trucked in.

The composting chamber is about 1.2 by two by 2.5 metres and can accommodate a family of five to seven, says Ostrowski. If a mid-section is used to stretch out the composting chamber, the toilet can accommodate an extra person or two.

Initial costs begin at about $2,300, comparable to a septic system, he says, and can rise according to the size and features desired. The toilet closely resembles traditional toilets, or can come in any decorative bench style desired.

About 90 to 95 per cent of the waste is evaporated due to the high working temperature of about 32 degrees Celsius in the heap. Odors are controlled by a simple ventilation system.

However a system must be used to handle the greywater, water containing detergents and greases which are put down kitchen and tub drains. These systems range in price from about $200 to about $400, he says.

Ostrowski says his customers opt for either a trickle filter system or a weeping tile field similar to that at the end of a septic system.

A trickle filter system filters the greywater through a container of sand and gravel, removing the silt. The water is then clean enough to use in the greenhouse or on the lawn or garden. Some people install heat exchangers on the system to capture and use the heat energy given off from the water.

A weeping tile field for greywater is much like that used in a septic system except that because there are no solid wastes, a septic tank is unnecessary. The water is drained or pumped into the weeping tile field for evaporation and absorption, but there's less pollution danger if the system is located close to sources of drinking water or to the water table.

Ostrowski estimates about 12 composting toilets are in use in Alberta. Customers are mainly environmentally-conscious and willing to take the responsibility to see only biodegradable wastes go down the chute so the unit continues to work properly and maintenance-free.

"It fits in with our over-all design to be gracious to the environment," says the composting toilet fan.

Composting toilets are now being studied by various government departments wanting to learn more about them, he reports. Alberta Agriculture is monitoring one unit installed by Sunergy 18 months ago, in a passive solar house designed for a rural family near Carstairs.

Rapid dehydration units, called humus toilets, work on the same principle as a composting toilet except that the biological breakdown of waste is speeded up. The "plug-in" toilet has an electric heating element to heat the wastes to optimum temperature for biological action and a fan to encourage the optimal aerobic conditions.

Because the wastes break down faster the unit can be smaller than a composting toilet, but it has to be cleaned out more frequently — perhaps as often as several times a year.

"There's a great deal of confusion between composting and humus toilets," says Ostrowski.

Humus toilets, he reports, are less acceptable to energy-conscious consumers because they consume electric energy. "Why use energy to accomplish something nature will do itself over time?" he asks.

A separate system is again needed for greywater, and there's more to maintenance because "they do have moving parts which can break down." In addition, unpleasant odors can escape into the house during a breakdown.

Ostrowski says both types of toilets have been tried out in public settings in the United States, where an educational campaign has cut down on the littering and vandalism often feared.

Incinerating toilets, fired by oil, liquid propane or natural gas, burn the waste, releasing a small amount of gas and producing a sterile ash which must be disposed of. The toilets use no water, but plenty of energy, and leave the householder again to install a system to handle greywater.

Aerobic systems are somewhat like septic systems, only they put extra oxygen in the water by constantly agitating it, allowing for some bacteriological action to break down some of the waste.

Remaining waste is settled out, just as in a septic tank, and the semi-clear effluent is processed through a weeping tile field or is sanitized and re-circulated through the system.

Although combining treatment of greywater and sewage, this system uses energy and if the effluent is to be re-used it must be chemically treated with substances like chlorine or iodine.

Also new to the market is the recirculating toilet which uses a fluid-like oil or water to whisk wastes away to be stored or processed. The circulating fluid is then cleansed and used again and again in the system, cutting down on the water wasted in flushing.

Sharon Adams is a journalist in Calgary.

Maryhelen Vicars

When it comes to efficient sewage disposal

The Consumer Has A Role To Play

Most of us seldom think of what happens after the sink is drained or the toilet flushes. Unless we've recently moved from the country or a small town where temperamental septic tanks or chemical toilets demanded careful attention, we're likely to take efficient wastewater disposal for granted.

But washing things down a drain or flushing them down a toilet does not make them miraculously disappear.

Although flushing may seem like the easiest way to get rid of bits of this and dabs of that, items not meant for sanitary sewers have a way of hanging around to clog up the works or slow down the process — an expensive or even dangerous end to the "vanishing act" from the household drain.

David Spink of Alberta Environment's municipal engineering branch says the capacity of sewage systems can be broken down into two different but related functions: hydraulic and organic loading.

Hydraulic loading refers to the volume of water going to settling tanks; organic loading refers to the amount of organic material entering the system.

Treatment plants are set up to treat a certain concentration of organic material in waste water, Spink says. If that concentration is altered by the addition of either more water or more organic material, "you start to have problems."

In this part of the world fresh water is plentiful and fairly inexpensive, so most people use — and dispose of — far more water than they need. This adds to the volume of household sewage and dilutes it, putting a strain on the system.

"It's easier to treat a lower volume of high-concentration waste than a higher volume of low-concentration waste," Spink says.

Household sewage problems, whether caused by too much water or the wrong kind of waste, can be greatly helped by an increased awareness of the householder's responsibility.

Lauren Dale

"There's no way we can cut down on the amount of solid matter we excrete each day," says Peter Lawson, a Calgary pollution control consultant, but most other contributions to the system can be controlled to some extent.

Interviews with Lawson, Spink and other authorities in the field yield a kind of checklist for consumers. Their advice:

- **Don't waste water.**

In the toilet tank, a plastic bottle filled with water and weighted with small stones will reduce the amount of water used to flush — about 24 litres in a conventional toilet. A publication of the United States Environmental Protection Agency (EPA) suggests not using bricks. They may flake and clog tubes and valves. If you're replacing a toilet, consider a water-saving model which uses only about 14 litres.

Learn to take "sailors' showers." Turn off the tap while soaping up and shampooing — you'll save soap as well as water. A short shower takes far less water than a bath in a full (240 litres or more) tub.

Repair leaking toilets and taps. To test if your toilet is leaking, the EPA suggests, put a few drops of food coloring in the tank. If colour appears in the bowl without flushing, there is a leak.

Don't let the taps run needlessly. Clean razor and toothbrush with short bursts of water. A bottle of water kept cold in the refrigerator eliminates the need for running the tapwater until it feels cold.

There are a number of water-saving devices available. B.C. Hydro, reports the Vancouver Province in a recent article, has started providing "flow restrictors" for their residential customers. A kind of plastic washer, they're installed in the shower head to cut down on the amount of water flowing through it.

Modified shower heads, some adjustable, are available which also reduce the flow of water from the "normal" 24 litres per minute to as low as 10 litres per minute.

Householders need a little encouragement to save water, it seems.

Cal Johnston, manager of waterworks for the City of Calgary, says his department has commissioned a study of 10 Alberta municipalities comparing water use.

The study found that in communities where people pay a flat rate, water consumption is 53 per cent higher than in communities with metered water.

In Calgary, where most consumers pay a flat rate, the average per capita per day use of water is 806 litres; in Edmonton the figure is 509 litres.

The amount of waste water produced, according to figures provided by Spink, reflects this proportion.

In Calgary in 1979 the average household sewage flow was 677.8 litres per person per day. For Edmonton the estimated figure for last year was 480 litres per person per day.

While Calgary has less porous soil and drier weather which may call for more lawn watering, Johnston says the significant dif-

Lauren Dale

ference is the use of water meters.

Paying for the amount used encourages thrift, apparently.

- **Forget the garburator.**

Widespread garburator use can increase a system's organic loading by as much as 30 per cent, according to a Colorado study. Instead of food scraps going into the sewer, they should be put in the garbage — or better still, composted in the garden.

"This is something which shouldn't be going into the rivers," Lawson says. "It should be returned to the soil as part of nature's cycle."

While some communities have banned garburators because of the extra organic loading, no Alberta towns or cities have done so, Spink says.

Also adding to the organic load, although on a smaller scale, is the common practice of dumping kitchen waste down the toilet. These mouldy leftovers should go into a container and then out with the rest of the household garbage.

Fats should never go down a drain, Spink says — they "gum up" the collection system. They can be collected in a jar and thrown out.

- **Your toilet is not a wastebasket.**

Such things as paper diapers, dental floss, hair, or plastic tampon holders may seem harmless enough but can create havoc in the treatment plant. They should all be tossed in the bathroom wastebasket, not the toilet.

"I have sampled some systems where the sludge was the consistency of rope from both human and animal hair," Spink says. Matted hair makes the sludge thicker, and puts an extra burden on the plant's pumps.

Lawson says disposable diapers are an "absolute menace." When first marketed, they were advertised as "flushable," but the extra burden of paper was found to clog both toilets and treatment plants.

Plastic tampon holders are another hazard. They can get through the screens which are designed to protect pumps, and have to be skimmed off settling tanks, which creates extra handling problems.

Similar products using cardboard holders are available, but if the plastic type is chosen, the experts advise: don't flush.

The same advice holds for other non-biodegradable items including dental floss.

- **Watch the chemistry of your sewage.**

Sewage treatment depends on the action of bacteria which consume organic matter and break it down. As living organisms, they are threatened by toxic chemicals which may get into the system.

There was a real problem in some areas where DDT was banned a few years ago, Spink says. Many householders, in a hurry to get rid of the chemical, flushed it down their toilets and into the sewage system, where it wiped out large populations of bacteria, seriously hampering some systems.

Paints, solvents, pesticides and oil-based compounds should never be washed down a drain.

Putting flammable liquids into the sewer system contravenes most sewer bylaws.

The same cautions apply to storm sewers.

Householders should resist the temptations to use the storm sewer drains found on most streets as a handy disposal outlet for garden chemicals, paint solvents and the like.

In most cities the storm sewers are part of a separate system which is intended to carry rainwater more or less directly to the river. But almost half of the city of Edmonton is served by a combined system, in which the contents of both sanitary and storm sewers flow to the municipal treatment plant.

Maryhelen Vicars is a journalist in Edmonton.

If undelivered, return to:

Environment Views
Alberta Environment
9820 - 106 Street
Edmonton, Alberta T5K 2J6

CANADA
NATIONAL LIBRARY
BIBLIOTHÈQUE NATIONALE
GOVERNMENT PUBLICATIONS
COLLECTION
DES
PUBLICATIONS DU GOUVERNEMENT

Environment Update

'Private' Land Worries AWA

The Alberta Wilderness Association is concerned about a proposed act to regulate snowmobile use on Crown lands which have been leased to farmers or ranchers for grazing purposes.

The association notes that the act, which may be passed this spring, for the first time in Alberta's legislative history regards public lands as privately owned.

AWA president Dick Pharis says that, although directed towards a specific user group, and applicable only to the proposed Snowmobile Act, passage of the act "bodes ill for other members of the public."

The AWA's concern is that ultimately hunters, fishermen, hikers and others may find themselves similarly restricted from using leased Crown land.

Another recent AWA concern was the interest expressed by Summit Lime Works of Crowsnest Pass in obtaining exploration and development permits to open a limestone quarry in the Ptolemy Basin, in the upper reaches of Ptolemy Creek, south of Highway 3 through the Crowsnest Pass. The area is within the Prime Protection Zone under Alberta's East Slopes policy.

However the government has now turned down Summit's permit request.

Student Program Started

The environmental and social affairs department of the federal resource corporation PetroCanada has announced a summer professional development program for graduate students in the areas of environmental science and social affairs.

Students will work within the corporation on research into areas of interest, and at the same time be given some idea of how PetroCanada functions. The corporation will pay salaries and air fares to Calgary for students from across Canada.

Andrew Vaughan

Wastewater Seminar At U Of A

The University of Alberta's department of civil engineering is holding a seminar June 28 and 29 on the design of water and wastewater services for cold climate communities.

The seminar, to follow the International Association for Water Pollution Research conference in Toronto, aims to bring together scientists and engineers from countries with cold climate regions, to exchange information on environmental constraints and technological solutions to water and wastewater servicing problems in cold climates.

Seminar speakers from Norway, Sweden, Greenland, the United Kingdom, Alaska and Canada will be present.

Further information may be obtained from Dr. S.E. Hrudey (432-5122) or Dr. D.W. Smith (432-4138) at the University of Alberta department of civil engineering.

Public Input Sought

The Alberta League for Environmentally Responsible Tourism (ALERT) is requesting briefs from the public before proposing to the provincial government a management plan for the Kootenay Plains area.

Briefs will be heard May 12, 1980, at 1 p.m. and 7 p.m. at the Presbyterian Church Hall, 5004-50th St., Rocky Mountain House. For more information write ALERT, Box 1288, Rocky Mountain House, telephone 845-3668.

Mine Hearings End

Hearings into Union Oil's application to operate a coal mine at Obed-Marsh, near Hinton, have ended, and a decision is expected towards the middle of the year.

Issues that received attention during the hearings included the relative effects on wildlife of a conveyor belt or trucks to transport coal from the mine to the railway station, and the social impact on the town of Hinton of the growth which such a project would promote.

Ski Race Causes Concern

The recent World Cup downhill ski race at Lake Louise has caused renewed concern among environmentalists about the appropriateness of such an event in a national park.

The National and Provincial Parks Association considers that Lake Louise should not become a permanent venue for major ski events.

If you have a short news item of province-wide interest you'd like to contribute to Environment Update, please send it to the editor at the address on the Contents page. The editor reserves the right to select and edit the items.